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The Production of an Array of Equipment Such as This Can Be Very Seriously Impeded by Any Specifications, Requirements or Practices Which Interfere with the Smooth, Coordinated Operation of the Units

Mixing Cycle *and* Production *in Concrete Paving Work*

By ANDREW P. ANDERSON

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THE DATA presented by Mr. Anderson are secured from an intensive study of the field records of over a hundred going jobs. The figures, therefore, are not a representation of theories or opinions, but definite records of actual facts as they were found in the field. They should give highway engineers some much-needed quantitative information which will serve to measure the value of many details in our present concrete paving specifications and practices.

DURING the past seven years the Division of Management of the Bureau of Public Roads has made many field studies of going road construction projects in order to determine the various factors which control or influence the rates of production, and then to find or devise practical ways and means of utilizing this information to increase operating efficiency and decrease unit production costs. The accumulated records of these studies now also form a source of definite quantitative data for securing light on many other related points. In concrete paving work we have for example the question, "What effect does the length of the mixing cycle have on the rate of production?" on which these data seem able to shed considerable light.

Field Data Collected.—The actual effect on the rate of production of the various requirements in regard to the length of the mixing time, which have grown up with the rapid rise of concrete road construction to one of our major industries, has long been a debatable question. In order to secure some definite information on this point a detailed survey was made of the actual field data which have been accumulated by the engineers of the Division of Management in their production studies while personally on these jobs. In order to secure results which might be as fairly comparable as it is possible to obtain, only those jobs were included which were under complete state control, on which the mixer was rated as in good or excellent condition and on which trucks were used as the hauling equipment. The data on which this survey is based cover twenty states and involve the placing of 499,885 batches of concrete, largely with 27-E mixers and mainly during the years 1927 and 1928, and should therefore be sufficiently extensive to disclose such actual trends or tendencies as may exist.

In order to focus attention so far as possible on the single question of what effect the length of the mixing cycle has on the rate of production, the identity of the individual states has been suppressed and replaced by

numerals. Furthermore, the final tabulations have been summarized in Table I by states on the basis of the length of the average mixing cycles which the stopwatch studies show were actually used. This method of presentation has been adopted because of the fact that the length of the mixing cycle in any given state, so far as state highway work is concerned, is almost entirely controlled by the requirements written into the specifications and the manner in which these are interpreted and enforced, all of which are fairly uniform within each state.

Five groupings have been used in Table I: (1) those in which the mixing cycle averaged less than 80 seconds, (2) those in which the mixing cycle averaged between 80 and 85 seconds, (3) those in which the mixing cycle averaged between 85 and 100 seconds, (4) those in which the mixing cycle averaged between 100 and 120 seconds and (5) those in which the mixing cycle was found to be over 120 seconds. The same data, plotted graphically without reference to grouping, are shown in Fig. 1. Since the individual job studies do not cover the same length of time, weighted averages have been used in securing the respective state averages. The group averages shown in Table I, however, are straight averages, as this would seem better to represent the average conditions of an area representing several states.

Analysis of Mixing Cycle.—The mixing cycle is, of course, the time which must normally elapse between batches when the mixer is in continuous operation. Actually the mixing cycle is made up of three elements:

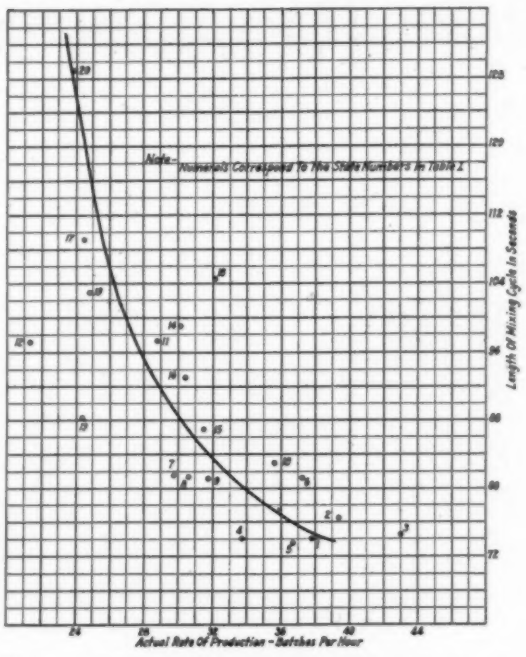

Fig. 1—Effect of Length of Mixing Cycle on Actual Rate of Production in Concrete Paving Work

This summary of a survey of going projects in 20 states includes only truck-haul jobs in which the mixer was in good to excellent condition.

TABLE I—EFFECT OF LENGTH OF MIXING CYCLE ON RATE OF ACTUAL PRODUCTION AND TOTAL CREW USED

Only truck-haul jobs on which mixer was rated as in good to excellent condition included

State No.	Specified Mixing Time, Seconds	Actual Mixing Cycle, Seconds	Actual Production, Batches per Hour	Total Crew, No. Men	Operating Efficiency or Total Possible Production on Cycle Used, Per Cent
			Group 1		
1	60	74.1	37.7	93	77.9
2	60	76.4	39.3	50	83.4
3	60	74.2	43.0	65	88.7
4	60	74.1	33.6	63	69.4
5	60	73.7	36.5	74	74.8
Averages	60	74.5	38.0	60	78.8
			Group 2		
6	60	81.1	37.1	79	83.6
7	60	81.8	29.7	60	67.5
8	60	81.4	30.5	82	69.0
9	60	81.3	33.7	54	76.1
10	60	82.9	35.6	65	82.0
Averages	60	81.7	33.3	68	75.6
			Group 3		
11	75	97.5	28.6	52	77.5
12	75	97.3	21.2	63	57.3
13	75	88.4	24.2	80	59.5
14	75	98.9	29.9	60	82.1
15	75	86.8	31.2	84	75.2
16	75	92.7	30.3	86	78.3
Averages	75	93.6	27.6	71	71.7
			Group 4		
17	90	108.9	24.3	70	73.4
18	90	104.4	32.1	65	93.0
19	90	103.2	24.8	76	71.1
Averages	90	106.2	27.1	70	79.2
			Group 5		
20	105	129.0	23.8	60	85.3

(1) the time required to get the batch into the mixer drum, (2) the mixing time or the time during which all the material must be in the drum and mixed in order to comply with the specifications or established practice and (3) the time required to get the mixed batch out of the mixer drum. In practice the mixing cycle is usually timed from the instant the mixer operator throws the lever to raise the skip, and advantage is taken of the extent to which certain parts of the operation actually overlap. Figure 2 shows quite clearly the sequence and average time required for each of the various operations involved in passing a batch of concrete through the mixer when a 60-second mixing time is specified and to what extent these operations overlap.

It will be noted that the mixing cycle is really composed of two parts, the first and largest of which is the length of time during which the materials must be retained in the mixer drum in order to comply with the specifications or established practice, and, secondly, the time required for the operator and equipment to perform certain functions in getting the batch into the mixer drum and then getting it out again. The first varies from state to state, extending at present over a range of from 60 to 105 seconds. The second varies somewhat irregularly with the condition of the mixer, the character of the materials and the personal equation of the operator, but under ordinary conditions, with the mixer in good mechanical condition and the operator properly trained, usually lies between 13 and 18 seconds, except where prevailing practice requires the performance of some features of the mixing cycle or some independent or subsidiary operation in such a way as to extend unnecessarily the cycle or delay unduly the beginning of the following cycle. Thus, while the specification requirements of one state may add as much as 45 seconds to the length of the mixing cycle over that of other states, the operating conditions themselves, even when extremely adverse, seldom increase the mixing cycle by more than about 5 or 6 seconds; or, in other words, the variations which arise from the

ordinary necessary operating conditions are only about one-ninth as great as the variations we find due to the requirements imposed by different states in regard to the length of the mixing time.

Factors in Production and Cost.—Attention is especially called to the fact that the basic production data for each state shown in Table I represent not theoretical rates of production, but the weighted averages of actual production as secured on going projects during the time they were under observation by the engineers of this division. In so far as these data are pertinent to the points involved, they should be competent evidence in answering the question, "To what extent does the length of the mixing cycle affect the rate of production which can be secured under actual field conditions?"

As we glance over Table I, two things seem to stand out quite clearly: first, that under similar conditions as to operating efficiency or minor time losses, the rate of production as actually attained in the field decreases successively with each addition to the length of the mixing cycle; and second, that how nearly our paving outfits in the field actually attain the production which is theoretically possible under the various mixing cycles on which they are operating, depends not on the length of the required mixing time, but on the efficiency with which they are managed and the freedom with which they are permitted to function.

To appreciate fully the practical significance of these two factors, we must take into consideration another fact which, though but partly disclosed in this study, has been repeatedly emphasized by the studies of the Division of Management—that is, that under similar conditions the daily or hourly cost of operating a modern road-building outfit is practically independent of the rate of production. In fact, modern road building has become essentially a manufacturing process in which a large but necessary array of highly specialized movable plant and equipment, instead of stationary factories, is utilized in coordinated sequence to produce a finished product in permanent place on the right-of-way instead of in producing goods in a factory for delivery to the marts of trade. Furthermore, the daily cost of operating such a concrete paving outfit, including depreciation, all overhead, supplies and labor, but exclusive of materials and hauling, is in the neighborhood of $400 per day, or $40 per hour on a 10-hour-day basis. Consequently, if the mixing cycle is approximately 75 seconds, or as shown in the first group of states in Table I, we may reasonably expect that for any considerable group of contractors operating on this cycle the rate of production will average about 38 batches per operating hour and the cost of producing each batch will be approximately $1.05 per batch. On the other hand, if the requirements are such as to compel the use of a cycle of 129 seconds, as shown in the last group, the rate of production may be expected to drop below 24 batches per hour and the cost of production to rise approximately 60 per cent, or to about $1.68 per batch.

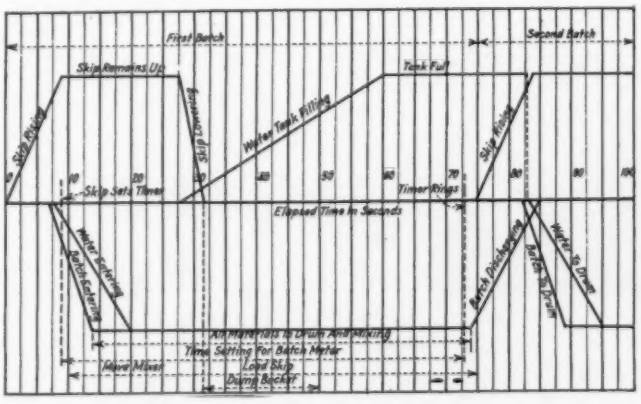

Fig. 2—Average Operating Characteristics of a 27-E Paver Working Under a 60-Second Mixing Time

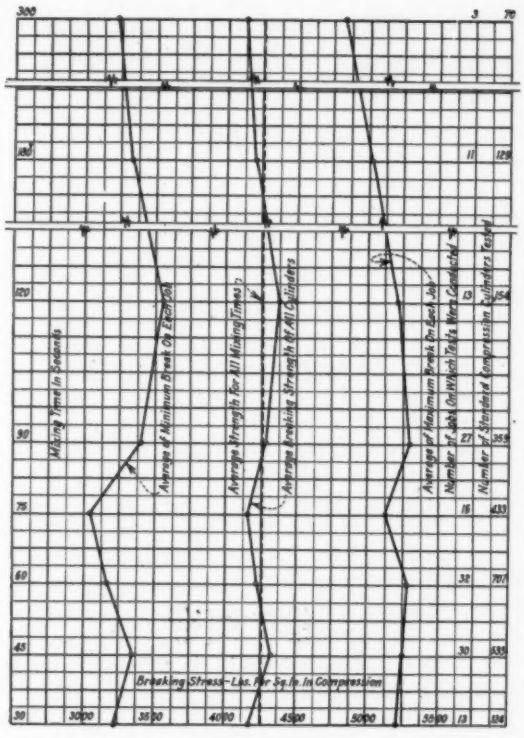

Fig. 3—Effect of Mixing Time on Strength of Concrete

Average values secured from breaking 2 50? cylinders with a mixing time of from 30 to 30) seconds.

This at once raises the question as to whether, with our modern concrete paving plants, a longer mixing time or requirements which unduly increase the length of the mixing cycle yield any returns which are sufficient to compensate us for these extra costs.

Returns and Costs.—To duck these questions by the plea that contractors do not evaluate such items as differences in the length of the mixing time in making up their bids is neither scientific nor commendable. In the long run, bid prices represent cost plus a margin of profit which varies considerably with the intensity of the competition for the work to be done. Consequently, we can hardly escape the conclusion that requirements which generate costs, either directly or indirectly, will always somehow be reflected in the bids submitted by an able and intelligent contracting fraternity. Even the highway engineering profession is not likely to be the first to succeed in solving the age-long attempt of getting something for nothing. It would therefore seem far better to admit that to have and to operate a plant such as is now required for modern concrete paving work costs money, probably between 65 and 70 cents per minute of the working day. Consequently, if we fix our requirements so that the contractor can actually produce, for example, a batch every minute and a half, the cost will naturally be lower than if we fix the condition so that he can produce only one batch every two minutes. The whole question of the value of cost-generating requirements then becomes simply whether or not they produce returns commensurate with their cost.

The length of the mixing time is, as we have seen, one of the main elements in fixing the length of the mixing cycle. Figure 3, which summarizes the breaking strengths in pounds per square inch of over 2,500 individual standard compression cylinders made on 34 different jobs under normal field operating conditions, except that the mixing time was varied as much as from 30 to 300 seconds, may therefore prove helpful in further studies of some phases of this question which is so important to both the highway builder and the taxpayer. These cylinders were all taken from modern 21-E and 27-E mixers operating on state highway jobs under actual field conditions with no modifications other than the length of the mixing time.

Major and Minor Time Losses.—From a further consideration of the data in Table I, it will be noted that as the mixing time increases, the relative difference between the number of batches which it should theoretically have been possible to produce and the number actually produced decreases somewhat for the two longest mixing cycles. This is to be expected, since the difficulty of coordinating a number of individual operations such as exist in laying concrete pavement increases as the time interval during which the coordination must be made decreases. Furthermore, stop-watch studies of many hundred outfits operating under nearly all kinds of job conditions show that on the basis of the production which should be secured and the production actually obtained, no job ever operates for any considerable length of time at 100 per cent efficiency. From extensive stop-watch studies on more than one hundred concrete paving jobs throughout practically all parts of the United States, it has been found that what might be called the average concrete paving outfit, when actually on the job trying to pour concrete, is losing about 26 per cent of the time in minor interruptions and delays each less than 15 minutes in duration. In fact, the great bulk of these losses are usually each of but a few seconds in duration but of a repetitive character so that they are repeated over and over again until their total becomes a real factor in determining the rate of production. Table II shows the average amount and distribution of these time losses as found from actual field studies on over a hundred going projects and should therefore represent fairly closely about what might reasonably be expected on the average random concrete paving job. This table also shows what portion of the available calendar days was lost in major time losses, or those in which each stop or delay was 15 minutes or more in duration.

Of the total calendar working days which are available to the average concrete paving contractor after he has secured his contract and moved his outfit on to the job, 17.5 per cent are lost because of weather conditions and 3.5 per cent in moving his loading plant from one set-up to another. Another 19 per cent of the available calendar working time is lost for various causes, the most of which are more or less definitely subject to control by the management. All of these time losses, however, were due to definite stops or delays, each 15 minutes or more in duration. They can, therefore, have had no appreciable effect on the net rate of production. Their effect was rather to reduce the number of hours of actually available operating time regardless of the rate at which the outfit was operating between stops. In other words, these major time losses which are made up of definite stops of from 15 minutes to several days, on the average concrete paving job, are entirely independent of the length of the mixing cycle. The weather losses, for example, may be expected to form about as large a percentage of the total available calendar working days on any given job regardless of whether the

TABLE II—TIME LOSSES ON AVERAGE CONCRETE PAVING JOB

Average values from a summary of field studies on more than 100 jobs

Major Time Losses

Each stop 15 minutes or more in duration

Cause	Per Cent of Total Available Time
Rain	9.5
Wet subgrade	8.0
Lack of prepared subgrade	3.0
Lack of materials	3.5
Moving plant set-up	3.5
Inadequate supply and faulty operation of hauling equipment	3.0
Mixer trouble	2.0
Lack of water at mixer	2.0
Loading plant trouble	1.5
Miscellaneous	4.0
Total	40.0

Minor Time Losses

Each stop less than 15 minutes in duration

Cause	Per Cent of Actual Working Time
Supply and operation of hauling equipment	12.2
Lack of or trouble with water at mixer	3.2
Lack of materials and supplies in place	1.1
Mixer trouble	1.9
Mixer operator	2.1
Finishing	0.7
Subgrade delays	2.7
Miscellaneous causes	2.1
Total	26.0

Mere Numbers Can Readily Be Used to Give Weight, but Rarely to Give Low Unit-Costs

mixer cycle was long or short. The other major time losses are more amenable to control by the management and will, therefore, almost invariably be found to be relatively low on a well managed job and relatively high on a poorly managed job, without regard to the length of the mixing cycle.

Any stop or interruption less than 15 minutes in duration to the steady and continuous operation of the key equipment at its normally rated capacity is in this discussion termed a minor time loss. Usually the most serious ones are recurring interruptions, each only a few seconds in duration, but which are repeated every cycle and are generally caused by improper coordination of the various operations or by improper operation of the equipment. The great majority of these interruptions are subject to more or less complete control by the management, and the extent to which they affect the rate of production is therefore an indication of the efficiency with which the management is functioning, or occasionally to some extent the freedom with which the management is permitted to function without undue restrictions from inspection and engineering control.

Some, however, are due to such causes as improper setting of the timer on the mixer; materials, such as fine wet sand, which discharge very slowly from the skip, and specification requirements or practices in regard to subsidiary operations which do not conform to the conditions imposed by the key equipment. Thus, we still occasionally find inspectors and even engineers who insist on setting the timer without taking into account the time it takes after the bell sounds for the operator to react and the mechanism to function so as to actually start the discharge. Some will even forbid the starting of the skip until the discharge gate is closed. All of these latter practices have a tendency to lengthen the mixing cycle.

Influence of Established Requirements.—Sometimes we also find that practices or requirements in setting steel, placing dummy joints, checking subgrade, etc., are such as to cause a lengthening of the normal mixing cycle sufficient to bring it into harmony with the time required for the subsidiary operation. Thus, for any given set of job conditions and grade of management we can fairly expect the net rate of production to be largely or entirely dependent on the length of the mixing cycle which is being used.

Established requirements and practices are the main reasons why we frequently find a considerable variation in the length of average mixing cycles among states which specify the same mixing time. Thus, where a 60-second mixing time is specified it is actually possible to operate on a mixing cycle of about 73 seconds, provided the mixer is in first-class condition and the materials are fairly dry and flow readily; and a cycle of 75 seconds is generally conservatively ample.

Average Actual Cycles.—By referring to Table I, however, we find that of the ten states covered in the survey which require a 60-second mixing time, only five were actually operating on an average mixing cycle below 77 seconds. The five other states which specify a mixing time of 60 seconds were actually operating on an average cycle of between 81 and 83 seconds, or about 10 per cent above the average of the first group of five states. Much the same is true of the other states also. Thus, of the states covered by this survey which required a 75-second mixing time, we found only two which operated very near to the minimum possible mixing cycle, while the highest was nearly 12 per cent above this minimum. Even in the one case where a 105-second mixing time was specified, the actual mixing cycle was found to be 129 seconds or about 9 per cent above the minimum possible. A long mixing time can, therefore, not be defended on the ground that it decreases otherwise inevitable losses or additions to the length of the mixing cycle. In fact, the data rather indicate that a long mixing time is an invitation to tolerate or add additional time-consuming practices or requirements.

Added Time vs. Added Cost.—When viewed in the light of all the various factors which control the actual rate of production in concrete paving work, these data seem to admit of no other conclusion than that the rate of production which is and can be obtained in the field decreases very rapidly as the length of the mixing cycle increases. Furthermore, while the rate of production decreases with an increase in the length of the mixing cycle, the hourly or daily cost of operation remains practically constant. Unit operation costs may, therefore, roughly be said to vary inversely with the rate of production. This then brings the highway engineering profession face to face with a question which these data squarely raise but to which they contribute no answer: "Do the various time-consuming requirements which we now impose as specifications or practices in placing concrete pavement contribute sufficient additional value in strength or quality to compensate for their additional cost?" Do, for example, the requirements which necessitate the use of a 105-second mixing cycle produce a concrete worth approximately 45 cents a batch more than that which is produced by other states under requirements which permit the use of a 75-second mixing cycle?

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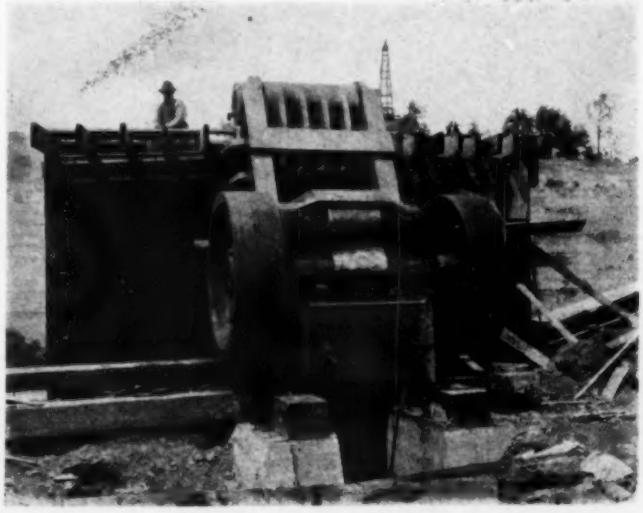
Large Welded Breaker in Operation

What is said to be the largest welded breaker in this country, built by the New England Road Machinery Co., has undergone successfully a test of several months of hard usage at the plant of the Saugus Sand & Stone Corp. This is a 42x48-in. breaker and is now operating at the rate of 15 tons per minute with the jaws set to 5 in.

The main part of the breaker is electrically welded. The use of this type of construction reduces the weight of the machine considerably below the weight of a machine using castings, it is stated. The breaker has a total weight of 80 tons, and was moved from the factory to the plant where it was installed, in two sections. Manganese steel is used in all wearing parts.



New Welded Breaker Installed at Plant of Saugus Sand & Stone Corp.

Two Famous Highway Bridges

THE new Montreal-South Shore bridge over the St. Lawrence River, illustrated above, is one of the world's notable bridges. It carries vehicular, street-railway and pedestrian traffic between the city and the south shore, where many important highways converge. The total length of the structure is nearly two miles, and the cantilever has a center span of 1,097 ft.

Below is a view of the new bridge over the Raritan River near New Brunswick, N. J., for the design of which Morris Goodkind, bridge engineer, New Jersey State Highway Commission, won the 1930 Phoebe Hobson Fowler award of the American Society of Civil Engineers. This award, which was established by Charles Evan Fowler to recognize architectural merit in the design of bridges, went to Gustav Lindenthal last year. The bridge consists of six 202-ft. open-spandrel reinforced-concrete arches, flanked by four 40-ft. barrel arches on the north end and five similar spans on the south end. It carries a 50-ft. roadway and two 6-ft. sidewalks.

Denver Salvages Asphalt Topping

By Jos. C. Coyle
Englewood, Colo.

Reclaiming Plant with C. H. Draney in Foreground

An important feature in the upkeep of the asphalt-paved streets of Denver, Colo., is the well-equipped asphalt plant of the city, where not only is new surfacing material prepared, but equipment is in operation for reclaiming a large portion of the old surfacing which is taken up in making repairs. The main plant, for new asphalt, and the smaller unit for preparation of used surfacing, along with storage space, etc., cover three acres of ground and are valued at $68,000.

Storage tanks, equipped with steam coils for heating, furnish both plants with asphalt, the tank of the large unit holding 260 tons. Storage sheds hold three carloads of cement, filler and Celite. There is open storage space for 2,000 yd. each of crushed rock and sand and 4,000 tons of used topping for reclamation; 40,000 gal. of fuel oil is also kept on hand. A derrick with 80-ft. mast and 75-ft. boom is used in storing aggregates, filling the hoppers to the main plant, unloading cars and loading trucks. Crushed granite is shipped in by railroad and two grades of sand are contracted for from local gravel firms and hauled in by truck. The three hoppers serving the main plant hold 20 cu. yd. each, with chutes leading from each to the foot of an 8-in. elevator. A man stationed at the outlet regulates the flow of aggregate. The hoppers are loaded with a ¾-yd. clamshell by the derrick. The latter is operated by a 4-drum American hoist with a 37-hp. General Electric motor.

The elevator carries the aggregate into the 24-ft. by 54-in. dryer, from which a hot elevator distributes it to the bins above the mixer. Two of these hold 15 yd. of sand and rock. A third bin holds 20 tons of lime dust. A Barber weigh box and mixer are used, the former holding 9 cu. ft. and the mixer having a capacity of 1,000 lb. per batch. Aggregates are weighed carefully, as is the asphalt. This is pumped from the storage tank to two 10-ton melting kettles by a Kinney 3-in. pump and from the kettles to the weighing device by a 2-in. Kinney pump. The capacity of the plant is 2,000 yd. per day. Rock from ¼ to ¾ in. in size is used for coarse aggregate with 30 per cent sand, 7 per cent asphalt and 6½ per cent filler. For sheet asphalt the mix is 12 per cent each of asphalt and lime dust, 4½ per cent Celite and the remainder sand.

The smaller unit, manufactured by Warren Bros. Co., is operated with a 40-hp. Fairbanks-Morse motor and has an Iroquois asphalt pump. The drum is equipped for drying at one end and mixing at the other, each end holding a batch at a time. The used asphalt surfacing is stored nearby and is ground in two hammer crushers. One of these is a Noyes, run by a Fairbanks-Morse 20-hp. motor; the other is a Williams, operated with a General Electric 20-hp. motor. The plant was formerly operated by steam, and is equipped with a Kewanee boiler. It has a capacity of 800 yd. daily.

Tests by the city laboratory and actual use of the

Removing Old Surface with Pneumatic Tools

Storage of Used Topping

"Ringing" a Bad Spot

Applying Hot Surfacing

reclaimed asphalt show that only the lighter oils evaporate from the surfacing under ordinary conditions, leaving the bitumen content practically intact as a rule. In removing failed areas of surfacing, that which appears to be good is hauled to the plant for regrinding. The reclaimed mixture is used both hot and cold. When used cold, for winter patching operations, a small amount of road oil is added and such patches often remain in good condition through the following summer. Though occasional cracking has occurred in areas of the reclaimed surfacing applied hot, general results have been satisfactory, according to C. H. Draney, superintendent in charge of the plant. The reclaiming material requires only from 2 to 4 per cent of new asphalt to bring it up to standard.

At the close of 1929 there was 1,400,000 yd. of asphalt paving under maintenance in the city, the first having been laid in 1891. A total of 500,000 yd. more will be under maintenance at the close of 1930. In addition to this the department has the maintenance of 2,000,000 yd. of alley paving and 207,000 yd. of stone and wood-block pavement. Most of the asphalt surfacing has been applied in later years, there having been only 1,393,573 sq. yd. at the close of 1923. At the close of 1929 the total asphalt surfacing amounted to 3,318,662 sq. yd. A total of $118,000 was spent last year for concrete, stone and asphalt repairs and resurfacing, including $4,355.69 for filling cracks.

In making repairs two Equitable surface heaters are used where it is feasible to employ this method. In other places the failed surfacing is removed, entirely or in part, and the area is filled in with fresh material delivered hot from the plant in canvas-covered trucks. This is raked in and rolled with an 8-ton roller. Two crews are employed on repairs, the larger crew being equipped with a steam roller, oil-burning tool heater, 160-ft. Ingersoll-Rand portable compressor with two Ingersoll-Rand paving breakers and a Gardner-Denver 160-ft. compressor with two Gardner-Denver breakers. The smaller crew, working on cuts made by public utilities, cracks, etc., is equipped with a truck, an oil-burning tool heater and a hand roller. The asphalt plant operates from March 1 to Dec. 1. Other equipment includes a Corliss engine at the main plant, a Heine boiler, a blacksmith shop for making plant repairs, one Littleford tank wagon, two other improvised tank wagons and a small kettle on wheels. There are 12 trucks of various makes and sizes used by the department, in addition to an 18-ton truck used in moving the rollers from place to place.

Slag from old smelter dumps near the city has been used considerably as a base in the past, but this practice has been discontinued with exhaustion of the supply. About 30 per cent of the asphalt is laid on concrete base; the remainder on slag, macadam and rock and black base.

C. D. Vail, manager of parks and improvements, is head of the department. C. H. Draney is superintendent in charge of the paving plant and maintenance operations, and J. R. Banning is assistant superintendent.

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U. S. Field Office Opened in Panama

To cooperate with the governments of the Central American countries in making preliminary surveys to determine the most desirable route for an inter-American highway, the Bureau of Public Roads is opening a field office in Panama City, the U. S. Department of Agriculture has announced. E. W. James, chief of the Division of Highway Transport of the bureau, who is in charge of organizing the work, sailed for Panama on June 21. Thomas A. Forbes and D. Tucker Brown, senior highway engineers, and Marcel J. Bussard, assistant highway engineer, will constitute the bureau force of the Panama City field office.

Congress authorized this cooperative effort and appropriated $50,000. The Inter-American Highway Congress in October, 1929—held at the invitation of the Republic of Panama in Panama City to discuss the road problems that each country would have to solve to make possible a connecting road—asked the Pan American Union to appoint an inter-American highway commission of from three to eight members from the participating countries to carry on the work of planning and constructing such a trunk line. Delegates from each of the Central American republics and from the United States attended the congress.

The Bureau of Public Roads will cooperate with the commission, the department explains, and will assist in making surveys only as the several countries request such help. Five of them, Costa Rica, Nicaragua, Guatemala, Salvador and Panama, have requested assistance or indicated their adherence to the plan. Guatemala, Costa Rica and Panama have asked for assistance.

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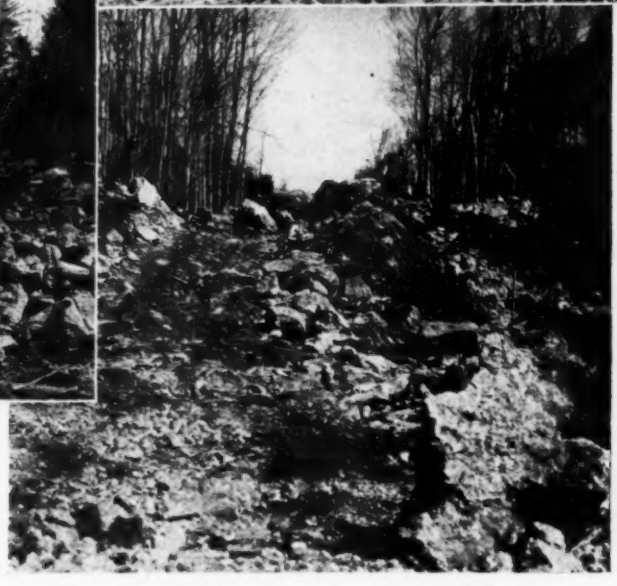
BILLBOARDS PROHIBITED.—No billboards are permitted within 500 ft. of highway intersections and turns or railroad grade crossings in Missouri. This law has been upheld by the state supreme court.

Road Relocation in NEW HAMPSHIRE

THAT rock holds no terrors for New England road builders might be inferred from these views of a winter construction project in the town of Stoddard, N. H. Relocation of 4½ miles of state highway through this region was made necessary by the construction of a 2,400-acre storage pond by the Public Service Co. of New Hampshire. The completed road will be of surface-treated gravel. The contract is held by the Arborio Construction Co., of Hartford, Conn., who will complete the work within a short time.

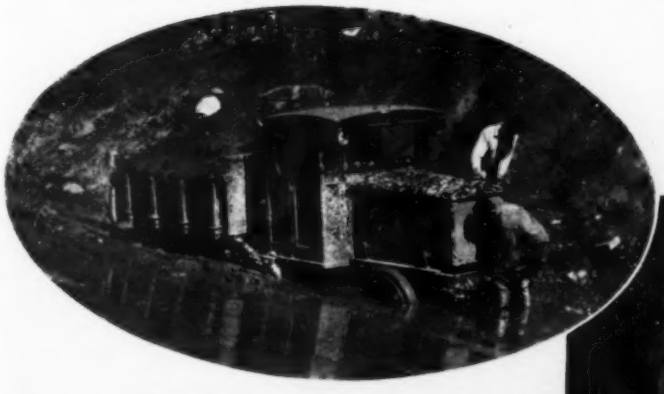


Showing type of country through which the new road was built

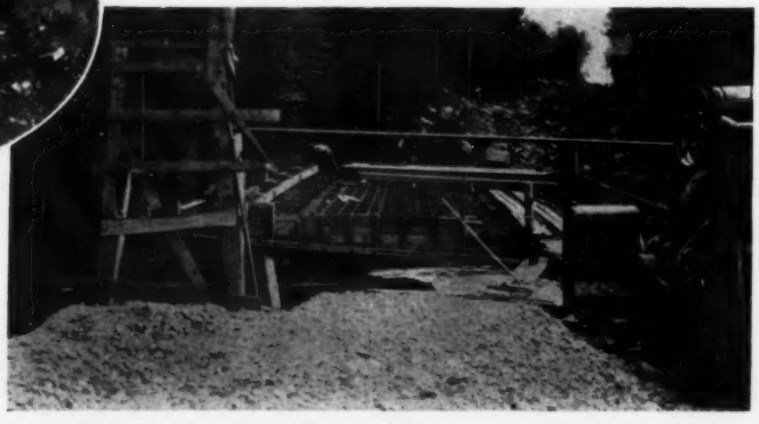
Photographs from

F. A. GARDNER

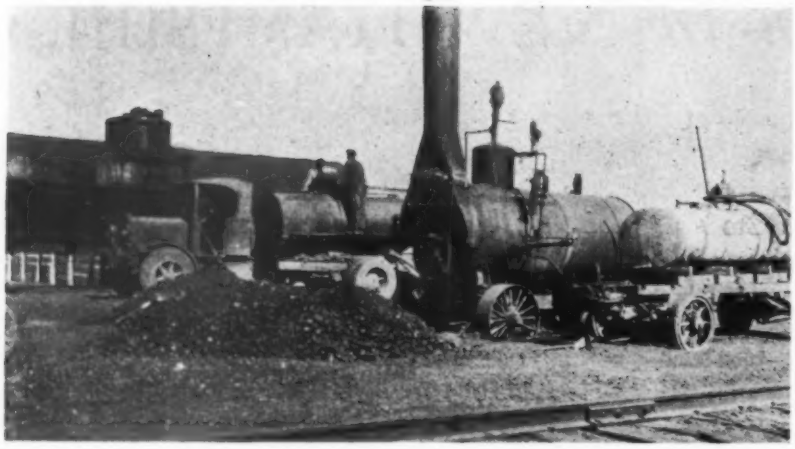
Assistant Engineer, Highway Department, Concord, N. H.



Above — Result of early spring thaw in cut section of new road



Right — Concrete bridge under construction in town of Stoddard, N. H.



Heating and Loading Oil at Siding. Distributor is Shown Between Boiler and Railroad Car

Construction Oil-Mix *in New*

By R. W. BENNETT

Office Engineer, State Highway Department, Santa Fe, N. Mex.

THE oil-processing of roads in New Mexico came, like many other improvements, as the result of necessity. High speed of motor cars and the excessive weights of trucks and buses, coupled with large increases in traffic, caused the gravel and stone roads of the state to become dusty, corrugated and expensive to maintain. In the long dry periods to which this section of the country is subjected, satisfactory maintenance became impossible of accomplishment. Traffic and high winds caused enormous losses in surfacing material, which the state, with its limited funds, could not replace. The Federal-aid roads were rapidly reaching a condition intolerable, not only to the traveling public, but to the Federal government, which had assisted largely in the cost of their construction.

In 1927 and 1928 a careful survey of the gravel road situation was made by the state highway department. An estimate was prepared of the amount of crushed material it would take to bring the Federal-aid roads back up to standard thickness. The estimated cost of this replacement material alone was in excess of a million dollars—and this replacement did not solve the problem; for the state was still confronted with an annual loss of this material at the rate of about 1 in. per year on 1,500 miles of surfaced Federal-aid highway. A sort of endless chain—with the expense becoming greater and the roads becoming poorer.

The necessity of going to a higher type was apparent. Yet there was also the necessity for economy, for New Mexico was a "poor" state with a large road mileage, and a large amount of expensive paving was out of the question. The need was for a smooth, semi-hard, dustless surface capable of economical maintenance. The result of all this investigation and study was the adoption of oil surface treatment of gravel roads.

Oil-Processing in 1928.—Oil-processing operations in New Mexico began May 1, 1928, with an experimental section 11 miles long in the central part of the state between Albuquerque and Los Lunas. This was not a Federal-aid project but a road being temporarily used as a part of a Federal route until funds became available for the building of a permanent road on the other side of the Rio Grande. New gravel surfacing was laid prior to oiling and a treated section 3 in. thick and 18 ft. wide was the result. This road has been fairly satisfactory, but on account of the fact that the original roadway was narrow and laid on a saturated subgrade, the shoulders failed somewhat under traffic and considerable maintenance has been necessary.

The Isleta-Los Lunas project was completed in June and the oiling crew moved to Federal-aid project No. 136 (2.8 miles near Los Lunas) and then to the Canoncito-Pecos Forest project between Santa Fe and Pecos on U. S. Route 66-85, on July 12. This 11½-mile

Disk-Harrow Falls in Immediately Behind Distributor and Performs Initial Mixing. This Allows Traffic to Use Road at Once Without Serious Inconvenience

of Low-Cost Roads *Mexico*

Distributor Spreading Oil on a Gravel-Surfaced Road Previously Prepared to Receive It

project had just previously been resurfaced with crushed material 3 in. in depth. The oil-processing was completed August 21 of that year. These three initial projects and the remaining 42 miles of oil-processed highway completed during the 1928 season were all of the "surface-treated" or "turnover" type, which has been largely used in New Mexico. The average cost of the 1928 work was $1,650 per mile for oil treatment only.

Work in 1929 and 1930.—One hundred and seventy miles of this type of construction were put down in 1929 at an average cost of $2,183 per mile. This figure does not include the cost of added crushed surfacing necessary for replacement on many projects. In addition a total of 30 miles was constructed by the "premix" or "plant-mix" method. The average cost per mile for this type of road was $5,270, which cost, of course, includes the added surfacing material.

Up to May 1, 1930, there have been placed 71.7 miles of the "road-mix" type, the oil-processing of which has cost $2,121 per mile—slightly less than the 1929 figure because of better weather conditions. Last year was an exceedingly wet year.

The first five projects oil-processed in New Mexico were 18 ft. in width, but it was early determined that this width was insufficient. Since October, 1928, the standard width for the oiled section has been 20 ft., and the "cake" or "mat" has been from 2½ to 3½ in. in thickness. The turnover process being the treatment largely practiced in this state, this method only is described in the following paragraphs.

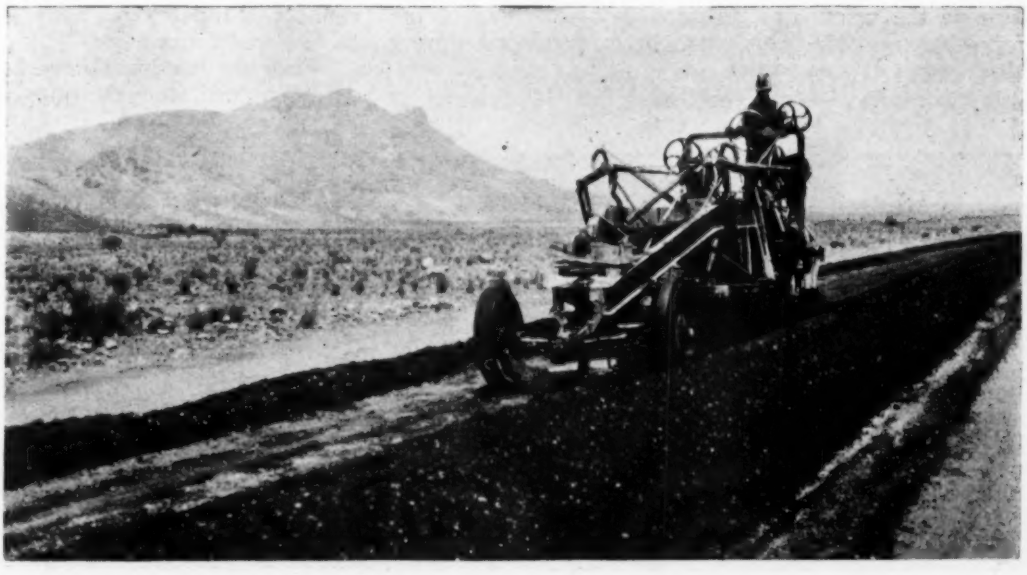
Amount and Grading of Treated Material.—Because of the large grading of gravel on early-built gravel projects (in some cases 2½-in. maximum) and heavy losses in surfacing material sustained on many projects, it has been necessary in most instances to add crushed material in sufficient amount to form the oiled mat. This, of course, has added to the cost of the reconstruction work, about doubling it, in fact, on those projects where such replacement has been necessary. On projects where there remains a sufficient thickness of gravel to form a good base and at the same time yield enough surface material of the proper consistency as regards grading to form the standard 3-in. oil mat, only scarification and perhaps addition of fines or dust are necessary, prior to oil treatment.

Whether new material is added or old surfacing scarified and oiled, the material to be treated should come within the following limits as regards grading:

Size of Screen, In.	Percentage Passing
1	100
¼	60 to 80
1/10	35 to 70
1/100	12 to 25

It should also contain from 5 to 15 per cent of material which will remain in suspension in water for several minutes.

In New Mexico sandy gravel has been treated and also crushed limestone, but sand has been added to the



Mixing Proper is Done by Means of One-Man Graders Operated by Experienced Hands. Usually Three or Four Machines Operate in Tandem to Facilitate Work

Project Completely Oiled and Mixed and Ready for Compaction Under Traffic After "Roll" at Right is Entirely "Laid Down"

limestone roads in the proportion of sand not less than 35 per cent of the whole. An appreciable amount of dust is essential—material so fine that it will remain suspended in water for several minutes. Where new material is added, the volume of this material is known and the amount of oil to be used is readily computed. Where an old surface is scarified, it is necessary to move the loose scarified material to one side in a windrow for measuring.

Quality and Amount of Oil.—The oil employed in processing is a fuel oil and has usually been specified as containing from 60 to 70 per cent of asphalt, varying from 80 to 100 penetration at 77 deg. F., and of 25 to 45 viscosity, Engler. The oil is heated at the tank car by means of steam coils, the heating unit consisting of a 25-hp. steam boiler. The temperature of the oil when pumped from the tank car into the distributor is approximately 150 deg. F. More recently the oil specified has been slightly heavier, being of 70 to 80 per cent asphaltic content.

The amount of oil required for satisfactory results has varied in this state from 1 1/3 to 2 gal. per sq. yd. Gravel having a minimum percentage of sand and dust requires less oil than material carrying high proportions of sand and dust. Mats containing larger percentages of fines and consequently greater amounts of oil have been found more impervious to water and are advantageous in regions of greater rainfall.

In New Mexico practice, samples are carefully screened from the roll or newly placed material to determine the amount of oil necessary according to the following formula which has been developed during observation of this work:

$$P = 0.02a + 0.07b + 0.15c + 0.20d$$

in which P represents the amount of oil necessary in pounds, a the amount of gravel material (in pounds) held on a screen having openings 1/48 in. in diameter, b the amount of material (in pounds) passing the 48-mesh screen and held on a screen with openings of 1/100 in., c the amount of material (in pounds) passing the 100-mesh screen but held on a 200-mesh screen and d the amount of material (in pounds) passing the 200-mesh screen.

Application and Mixing.—The amount of oil determined, the material, in the case of the scarified road, is spread to uniform thickness and the oil applied, usually in three applications of one-third the required amount of oil to each application. An expert man on the oil distributor is able to gauge his application of oil so that the required amount of oil is placed on the surfacing for any desired width over a given distance based on the distributor tank capacity.

Following each application of oil, a disk-harrow drawn by a tractor pulls in behind and starts the mixing of oil and gravel immediately. This operation only partially mixes the materials. When the gravel material is completely oiled the real mixing by means of one-man graders is begun. It is this operation which gives the process the name "turnover." The graders take a short section and blade the material all to one side. This is done in successive stages, a small amount at a time. The operation is continued until the treated material is in a windrow at one side; then it is picked up and moved in the same manner to the opposite side. The average number of times which the roll is moved varies from 30 to 40—sometimes more.

When the materials have become thoroughly mixed, as determined from their appearance and by stain tests,

Tractor and Blade are Used During Compaction Stage, Which Usually Lasts About a Week, to Insure Smooth Finished Surface

A Roller is Occasionally Used to Advantage Where Conditions are Favorable or Where Shoulders are Soft

the mixture is spread out uniformly to the width desired and is ready for compaction under traffic. During the time required for thorough compaction, which is usually from four days to a week, a light motor grader is kept moving over the mat to prevent the forming of ruts and inequalities and to insure a smooth riding surface.

Equipment.—The equipment required for the oil-processing of a section may be of interest. The following complement of equipment does not take into account any machinery necessary for the placing of additional crushed material, which would include crushing and screening plant, trucks, etc., but is the equipment used in oil-processing only:

4 15-hp. motor graders, crawler type, 8-ft. blade, with scraper attachments, for oil-processing.
2 offset disk-harrows, 9 ft. wide, for mixing behind the oil distributor.
2 15-hp. crawler-type tractors for pulling disk-harrows.
1 6-ft. rubber-tired grader for use in finishing.
1 10-hp. rubber-tired tractor for pulling 6-ft. grader.
1 25-hp. steam boiler for heating oil in tank cars.
1 1,000-gal. oil distributor.
1 1½-ton service truck.
1 light auto for foreman.

The approximate cost of this equipment is $30,000. According to the schedule of the Associated General Contractors of America, the daily equipment rental for such a complement of equipment would be $71.80.

Oil-Processing Crew.—The average working crew necessary to handle this equipment and to oil-process a gravel road properly (exclusive of placing additional surfacing) is as follows:

1 foreman, per month	$200
1 boiler engineer, per month	150
1 oil distributor operator, per month	175
1 swamper for distributor, per month	$150 to 175
4 motor grader operators, per month	$150 to 175
2 tractor operators for disk-harrows, per day	$4.00 to 4.50
1 tractor operator for light grader, per day	$4.00 to 4.50
1 grader operator, per month	150
1 service truck driver, per day	4

Operations frequently require the services of other labor as follows:

Inspector, per month	$175
Laboratory assistant, per month	125
Mechanic, per month	$165 to 175
Man on finishing blade, per month	150
Roller man, per month	150
Checker, per month	100
Truck driver, per day	4
Assistant fireman, per day	4
Laborer, per day	4

These workers are picked up or moved from one job to another as their services are required.

In addition to the construction crew, an engineer is placed in charge of each project, his duty being to make frequent tests to determine the proper amount of oil, insure a proper mix and secure a good finished job. His salary is from $190 to $210 per month. A superintendent has charge of all oiling operations in the state. With three or four oiling crews in operation, plans have to be well executed in order that there may be no lost time or idle equipment. Surfacing operations are carried on in advance of the oiling, so that when one job is completed the oiling crew may immediately move in on another project.

Costs.—For the purpose of analyzing costs and obtaining efficiency in oiling operations, costs have been carefully kept and separated under several heads. On 32 projects of the mixed-in-place type, totaling 301

Finished Oil-Processed Gravel Road is Dustless, Smooth-Riding, Largely Free from Corrugations and Economically Maintained

miles, average costs per mile treated have been as follows:

Moving, job to job	$ 45.34
Scarifying	31.26
Harrowing	110.46
Heating oil	58.71
Distributing oil	196.98
Processing	228.80
Spreading	33.22
Shaping and finishing	77.68
Oil, including freight	1,091.98
Equipment rentals	216.67
Testing	16.92
Total cost, per mile	$2,108.02

The average number of gallons of oil applied per square yard on the 32 projects referred to above has been 1.68. The average cost per square yard of surface treated has been $0.183, for a depth of approximately 3 in. As stated before, these average costs are for oiling only and include no resurfacing costs.

Bids taken on 65-70 oil this year have ranged from $2.20 to $2.41 per bbl. delivered in New Mexico. Bids on 70-80 oil recently received have been from $2.50 to $2.70 delivered. These prices are for the standard 42-gal. barrel.

While the earlier projects cost about $1,600 for oil-processing, this cost has risen to approximately $2,100 per mile. The reasons for the higher costs on later work are the following: wider roadway treated, heavier oil, rolling in some instances and weather conditions. During 1929 much moisture fell in New Mexico, and this slowed up the oiling work and raised costs considerably. Dry weather is essential to the success of oil-processing, both from the standpoint of the finished product and from that of economy. So far in 1930 very satisfactory weather conditions have prevailed; however, it is expected that costs will increase somewhat with the advent of the rainy season, which usually begins in July.

Resurfacing is about as expensive as oil-processing. Hence the total cost on resurfaced and oiled projects runs from $4,000 to $4,500 per mile. Bids received this year on crushed surfacing of rock or gravel placed on projects to be oiled have ranged from $0.80 to $2.28 per cu. yd. The average price has been $1.49 per cu. yd. for crushing and screening, hauling and placing of properly graded material.

Economy of Oil-Processing.—On Jan. 1, 1930, an investigation of maintenance costs by types was made. Gravel and similar roads were costing $230 per mile per year to maintain. Against this the oiled roads so far constructed show a cost for maintenance of $200 per mile per year, which includes the placing of a seal coat of oil and dust as often as is necessary. This is a direct net gain of $30 per mile per year.

The greater economic advantage of the oil-processed road over the gravel surfaced type, however, is not in the direct saving in maintenance, but in the conservation of the road metal. There is virtually no loss in surfacing material in the case of the oiled road. With the addition of a seal coat occasionally (once each year at least) it is estimated that an oiled road of this type will will need no other re-oiling for an indefinite period.

Investigation of a large number of projects constructed of gravel, crushed stone, caliche and selected material indicates that the loss of original surfacing is 1 in. in thickness per year. The average width of the projects under consideration is 16 ft., which means a loss of 260 cu. yd. of surfacing material per mile per year. At an average cost of $2 per cu. yd., the loss per mile per year on the original investment is $520. Add to this the maintenance cost of $230 and we have a total annual charge of $750 per mile. In the case of the oil-processed road we have an annual maintenance cost of $200 plus interest on the cost of reconstruction (6 per cent of $4,000), which is $240, or a total of $440. The net annual saving is, therefore, $310 per mile, which would be sufficient to pay off the extra investment of $4,000 per mile in 13 years. (The average cost of resurfacing and oil-processing one mile of road is taken as $4,000.)

And this is not all. The New Mexico roads which have been oiled carry conservatively an average traffic the year around of 300 vehicles per day. Each mile of road, therefore, handles 109,500 vehicles annually. The estimated saving in motor-vehicle operating costs, as between an oil-processed and a gravel surfaced road, is from 1 to 2 ct. per mile. Using the more conservative figure of 1 ct. per mile, the annual saving to motorists is $1,095 for every mile of oil-processed construction. Other advantages, difficult of computation in money but valuable from the motorists' standpoint, are a dustless surface, superior riding qualities and absence of corrugations. The oil-processed highway is a better public utility at a reasonable cost in a state where economy in cost of construction is a very important consideration.

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Street Sanitation Officials to Convene at Louisville

The 11th conference of the International Association of Street Sanitation Officials will be held at Louisville, Ky., Oct. 9-11. Conference headquarters will be at the Brown Hotel.

Among the topics discussed will be the following: The Effect of Street Cleanliness Upon Real Estate Values, presented by C. Robert Peter, director, Louisville Real Estate Board, Louisville, Ky.; Advertising the Service of the Public Works Department, presented by Capt. Harrington Place, engineer, Bureau of Governmental Research, Detroit, Mich.; Reduction of Organic Waste by Bacteriological Inoculation, presented by Mark B. Owen, commissioner of public works, Dearborn, Mich.; Salvage of Material in Municipal Refuse, presented by Thomas L. Costigan, superintendent of street cleaning, Washington, D. C.; Advantages of Bag Containers in Refuse Collection, presented by Arthur P. Heyer, director of public works, Montclair, N. J., and Management and Control of the City Dump, presented by Joseph J. Butler, superintendent, Bureau of Streets, Chicago, Ill.

Other subjects are garbage collection ordinances, presented by Carl Schneider, mechanical engineer, Division of Public Works, New Orleans, La.; cleanup weeks, presented by Covington K. Allen, engineer of street cleaning, Baltimore, Md., and street construction for cleanliness within railroad track zones, presented by P. J. Hurtgen, director of public works, Kenosha, Wis. Snow removal will be presented by James Garberg, superintendent of streets, Minneapolis, Minn., and Prof. Howard T. Barnes, McGill University, Montreal, Que. A report of the Committee on Uniform Street Sanitation Records will be presented by Joseph J. Petranek, commissioner of public works, Cicero, Ill., chairman. Ample time will be given for open discussion of each subject.

H. W. Fledderman, superintendent of street cleaning, Louisville, Ky., is chairman of the local committee on arrangements to cooperate with the Manufacturers' division.

A Discussion of
ROAD CAPACITY

Sunday Congestion on a Cook County, Ill., Highway

For uniform flow of vehicles a theoretical equation for capacity can be developed which will give maximum safe density of travel. In practice, theoretical flow is approximated when vehicles fall in line and travel at same speed

By N. W. DOUGHERTY
Professor of Civil Engineering, University of Tennessee

IN the development of the highway program many of the state departments have reached the point where they must decide on additional two-lane highways or increase the number of lanes on the present highways. A theoretical discussion of the capacity of a highway should be of interest and of some value in furthering the construction program.

Theoretical Capacity.—To arrive at a theoretical capacity we will make assumptions that can be analyzed mathematically. In a normal flow vehicles will travel at varying speeds to suit the convenience of the traveler until the number of vehicles begins to restrict the free movement and force all to move at the same pace. The adjustment will be such that the vehicles will be spaced at some safe distance apart, and as restriction continues they will be moving as one continuous stream. Making the following assumptions we develop an equation for the number of vehicles passing a point in a given period of time and also get the speed at which maximum flow should occur:

1. Assume that all vehicles in a lane move at a uniform speed.

2. Assume that they travel far enough apart to prevent collision if a vehicle ahead meets with disaster. This distance, of course, depends upon the ability of the brakes to stop the car and the alertness of the driver. To arrive at the proper distance three factors must be taken into consideration:

a. Overall length of the car and clearance, say 15 ft.

b. Braking distance, obtained by equating the kinetic energy in the car to the work done by the brakes;

$$wfs = \frac{wv^2}{2g} \text{ or } s = \frac{v^2}{2gf} = \frac{v^2}{38.6} = 0.0259v^2,$$

where:

w is weight of car (four-wheel brakes considered)
f is coefficient of friction (assumed as 0.6 for this study)
s is space required to stop
v is speed in feet per second
g is acceleration of gravity.

c. Time elapsed from the instant in which the driver observes disaster ahead until he can apply the brakes. Published tests on the reaction time of drivers give a variation from 0.2 to 1.5 seconds. Assuming 0.5 second as average we have a reaction distance of $d = 0.5v$. In

the two equations just written, v must be measured in feet per second. If the velocity in feet per hour be divided by the sum of the three distances given above we have the number of vehicles which could pass a point in one hour:

$$N = \frac{3{,}600v}{15 + 0.0259v^2 + 0.5v}$$

It is more convenient to use velocities in miles per hour than in feet per second. The following equation is, therefore, developed using V in miles per hour rather than in feet per second.

$$N = \frac{5{,}280V}{15 + 0.0556V^2 + 0.73V}$$

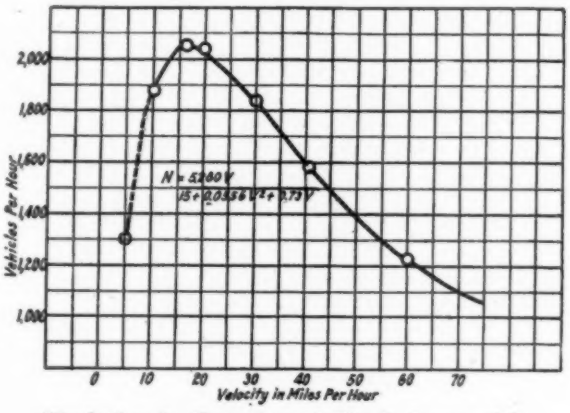
It will be noted that the number of vehicles varies with the speed of travel. If this equation be differentiated with respect to v and the first differential set equal to zero, we find the velocity at which maximum flow occurs. For the assumptions of distance given above, the maximum flow occurs at approximately 16 m.p.h. and is equal to 2,060 vehicles per hour. If a lane could be used at full capacity for 24 hours of the day, the number of vehicles passing would exceed that of almost any urban highway in the United States.

Practical Considerations.—The very nature of the traffic will not allow uniform speed. The greater the speed variation, the greater the effect on capacity. Were the traffic mixed, one-half moving at 20 m.p.h. and the other half at 40 m.p.h., a free lane would be needed to allow passage of the slower moving vehicles. From the equation it is observed that under this condition the capacity of the one lane would be decreased. The number of vehicles using the opposing lane would be reduced to a minimum. We may, therefore, expect on an open road a capacity of less than 50 per cent of the theoretical capacity for each lane of highway unless the vehicles are separated into lanes by speeds. The accompanying diagram shows graphically the variation in capacity with speed of movement. Now that we have had the theory we may inquire into the practice.

The first thing we note is that the distance between vehicles varies as the square of the velocity. Dean A. N. Johnson has pointed out that the spacing of the vehicles on the Washington-Baltimore road varies approximately as the 1.3 power of the velocity. If drivers in general follow this spacing the effect on capacity is less than that indicated by the theoretical equations.

The number of vehicles actually using the highway, of course, depends upon speed and combinations of speeds. A number of city streets are carrying 1,000 vehicles per lane per hour during the rush hours. This means that the vehicles are assuming practically uniform speed. One of the largest discharges reported is that of the Holland tunnel, of 1,900 vehicles in an hour. On most streets and highways the maximum demand lasts but a few minutes during the day. Dean Johnson reports 1,968 vehicles per hour for a 5-minute interval on the Washington-Baltimore highway.

Dr. J. G. McKay, of Cleveland, Ohio, reports 1,530 vehicles in one hour over one lane of the Superior Level bridge in Cleveland, the traffic moving at an average velocity of 12.5 m.p.h. The actual capacity on the road, therefore, approximates the theoretical values. The practical capacity of a two-lane road is not 40,000 vehicles per 10-hour day, but something far short of this amount. If all the vehicles moved at the same speed and if the movement were uniform for each hour of the day, 40,000 cars could pass a point on a two-lane highway. Since the speeds vary the capacity will be cut at least 50 per cent, as pointed out in the theoretical discussion. The peak hour during the day is 75 to 100 per cent heavier than the average hour; consequently, if the peak hour is cared for, the flow will be decreased again by 50 per cent, making the final expected discharge 25 per cent of the 40,000, or 10,000 vehicles per 10-hour day. In practice this agrees reasonably well with actual observation. The Washington-Baltimore pike carries 10,000 vehicles per day. The Gallatin pike out of Nashville, Tenn., carries 7,500 vehicles per day, 12 per cent of which are trucks. The Dayton pike out of Chattanooga carries 7,500 vehicles per day. A large number of highways throughout the United States are carrying from 7,000 to 10,000 vehicles per day. The writer has observed small interval rates of from 600 to 1,400



Variation in Capacity of Single Lane with Speed of Movement

vehicles per hour on two lanes. The 600-per hour rate cause little obstruction to the passage of the more slowly moving vehicles, but when the flow reaches 1,000 per hour the vehicles find difficulty in maintaining a speed faster than the slowly moving group. At 1,400 to 1,600, or 700 to 800 per lane, the vehicles are forced to remain in line for a larger part of the time, therefore traveling at a slower speed than they would use if there were fewer vehicles on the road. However, the actual discharge capacity of the road is not decreased by this process because the maximum flow occurs when the speed is uniform and at about 16 m.p.h.

Adequate Design.—After the highway has reached a two-lane capacity, should we add a third lane for passing purposes? There are a number of places where this solution should be counted good design. Whenever the preponderance of travel is in one direction during certain hours of the day and changes direction during some other hours of the day the three-lane highway will certainly be very useful. The objection is usually raised that no rule of the road covers the right-of-way in the third lane. This is true, but observations on three-lane roads seem to indicate that the drivers take no more chances than they do on a two-lane road where their right-of-way is defined by law and custom. Since the great majority of drivers are reasonably careful this objection can be given a large discount.

At the present time the four-lane road seems to be of sufficient width to carry most of the rural travel. It should carry a travel up to 30,000 vehicles per day because there is ample opportunity to separate the vehicles into classes based on two speeds. Where there are no horse-drawn vehicles, two speeds can be made to accommodate the total travel. On peak days the flow can well

be increased to 40,000 vehicles per day. Theoretically the capacity is more than 40,000 vehicles per day but practically there is difficulty because the peak flow is far from the average flow.

Whenever the travel reaches a larger amount than this a parallel road will probably be a more satisfactory design. There are a few cases where more than four lanes may be counted good design, but with the present vehicle movement it seems that these will be confined to urban or densely populated areas.

Effect of Grade.—In the theoretical equation developed above it was assumed that the vehicle was traveling on a level grade. On the ascent the braking distance will be decreased and as a consequence the theoretical capacity will be increased. On the descending grade the braking distance must be increased and it will decrease the theoretical capacity. The following equation is corrected to give the additional distance due to the pull of gravity:

$$N = \frac{3{,}600v}{15 + \frac{v^2}{2g\,(f-p)} + 0.5v}$$

when:

N = is number of vehicles per hour
v = is velocity in feet per second
g = is acceleration of gravity
f = is coefficient of friction
p = is rate of grade (e.g., for 5 per cent, $p = 0.05$)

For V in miles per hour, the equation becomes:

$$N = \frac{5{,}280V}{15 + \frac{2.15V^2}{64.4\,(f-p)} + 0.73V}$$

For rates of grade in common use it is seen that the effect is practically negligible.

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Sixth International Road Congress

More than sixty countries are expected to send official delegations to the sixth congress of the Permanent International Association of Road Congresses to be held in Washington, D. C., Oct. 6-11, it was recently announced by the American Organizing Commission, which is making arrangements for the meeting. By Aug. 5 a total of 55 governments had notified the U. S. Department of State that they would be represented, while word was expected from about ten other countries that they also would send delegations.

With that number of countries represented, the congress promises to be one of the largest international meetings ever held. While governments will participate in the deliberations, the meetings will be open to all members of the association. Membership in the association is open to anyone interested in its aims and on its lists are found professors, government officials, engineers, contractors, societies and clubs, in addition to governments.

The congress this year will discuss not only the different types of construction, but also will go exhaustively into the subject of financing, construction and maintenance of highways, as well as the question of traffic movement, a question that grows in direct proportion to the number of automobiles in use. Treating these subjects, a total of 76 different papers has been submitted by various delegates and these have been published in the four languages of the congress: English, Spanish, French and German. Governments which announce their intention of sending delegations to the Congress are as follows:

Algeria, Anglo-Egyptian Sudan, Belgium, Bulgaria, Canada, Chile, China, Colombia, Costa Rica, Cuba, Czechoslovakia, Denmark, Ecuador, Egypt, Finland France, French West Africa, Germany, Great Britain, Greece, Guatemala, Hongkong, Honduras, Hungary, India, Indo-China, Irish Free State, Italy, Japan, Morocco, Netherlands, Netherland East Indies, New Caledonia, New South Wales, New Zealand, Nicaragua, Nigeria, Northern Ireland, Norway, Panama, Poland, Portuguese East Africa, Queensland, Rumania, Salvador, Siam, Spain, Sweden, Switzerland, Tunisia, Turkey, Union of South Africa, Syria, Venezuela, and Yugoslavia.

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Highway Expenditures Increase

New highway construction alone in the United States this year is expected to exceed the outlay for that class of public works last year by more than $250,000,000, which will bring the total 1930 expenditures for roads and bridges constructed by the Federal, state, municipal and other local governments throughout the country close to $1,750,000,000, according to a survey just made public in Washington by the Committee on Recent Economic Changes of the President's Conference on Unemployment. Among the many projects which were pushed ahead to offset business depression, highway construction is likely to show the largest increases when final records for 1930 become available, the survey observes.

Actual expenditures for the construction and maintenance of bridges and roads, not including various overheads and the cost of equipment and materials, the survey states, rose from $784,000,000 in 1923 to more than $1,237,000,000 in 1928, and the annual cost of maintenance alone is now rapidly approaching $500,000,000.

Federal expenditures on road building, including Federal aid to states and forest roads, have averaged about $90,000,000 annually during recent years, the survey notes. The appropriations for Federal highway construction for 1931, 1932 and 1933 have been increased from $75,000,000 to $125,000,000 annually. Last year the Federal government spent $101,212,185 on roads, mostly in the form of aid to states. Federal-aid appropriations are matched with state funds, the survey explains.

Figures on income and funds available for state and local highway and bridge work contained in the survey show that the main sources of meeting the cost of new state roads throughout the country are motor-vehicle fees and receipts from the tax on gasoline, the latter being the leading item.

Out of income and funds available for state roads during the years 1923-1928, amounting to nearly $4,000,000,000, in that period, nearly $2,400,000,000 was derived from motor-vehicle fees and the gasoline tax together, motor-vehicle fees providing about $1,265,280,000, and the gasoline tax about $691,000,000. Funds from the gasoline tax, which totaled $15,872,884 in 1923, had risen to $234,163,826 in 1928, being the leading item of sources to meet highway construction costs in that year. Funds provided by the Federal government in the 1923-28 period were somewhat less than $500,000,000.

NEBRASKA Builds *Mixed-in-Place*

Pictures from

A. M. GADDIS

Construction Engineer, Bureau of Roads and Bridges, Lincoln, Neb.

Above is shown a section of a completed highway surfaced with road oil mixed in place to a depth of approximately 5 in. on a very fine grade of sand, commonly known in Nebraska as "blow" sand. This stretch of road has been down for practically a year and presents the appearance of an asphalt-top road. This type of construction is felt to be the solution of a difficult problem in Nebraska, and should be successful under similar conditions elsewhere.

In constructing mixed-in-place surfaces, manipulation of the oil under the sand is accomplished by the use of disks and tractors. The mixture is bladed to its full depth until the oil is thoroughly mixed with the sand.

[[NEXT MONTH: PICTURES FROM TEXAS]]

This surface, 50 miles east of Alliance, on Nebraska Route 2, is built of a mixture of oil, fine gravel and sand, and is laid on a gravel base to a depth of approximately 3 in. This material was placed on the road by the use of blade graders and disks. As the picture shows, it makes an excellent surface.

EDITORIALS

The Significance of the 37 Per Cent Increase in State Road Contracts

THE Hoover policy of increasing public-works construction during dull times has met with almost universal support. Recent reports from the state highway departments of 44 states give the following totals as to contracts awarded during the first 6 months of 1929 and 1930:

First half of 1930	$359,073,573
First half of 1929	261,606,212
Increase for half-year	$ 97,467,361

This is an increase of more than 37 per cent.

Thirty-nine of these 44 states reported that during the second half of 1930 they would award contracts for at least $181,671,974 worth of road work. It should be noted that these totals do not include work done by the state's own forces, such as maintenance, nor do they include county, parish or township road work, nor Federal road work. Furthermore, city street work is not included in these figures.

The significant fact in this summary is that the states responded promptly and liberally to the Hoover appeal, and that it shows conclusively that his policy of increasing public-works construction has met with almost unanimous approval. This is particularly gratifying because never before has such a policy been tried on a large scale in America, as a means of reducing unemployment.

Federal statistics show that 1930 expenditures for public works by cities, counties, states and the Federal government will exceed those of 1929 by more than 12 per cent. It is obvious that increments in highway expenditures will exceed this general average of 12 per cent.

During a depression period construction work is always performed more cheaply, not only because of reduced prices but because workmen exert themselves more strenuously. Hence if a given piece of public work is really needed, the public obtains it at a bargain. As to the need of road and street improvement, few people have raised any question. The few objectors against increased taxes for highway improvement have usually been men unacquainted with the extent of the economic need for better highways. They have failed to see the full significance of the great increase in automobile travel. The "two-car family" is no longer a dream, for in several states the "three-car family" is already beginning to be talked about as the next step. A car for the husband, a car for the wife and a car for the "kids" may be seen today in thousands of families that are far from being rich.

The "two-car family" is no longer the ultimate goal in those sections where the "three-car family" is not uncommon.

Whatever may be the opinion of any man as to American "extravagance" in motor-car ownership, the fact is that the great majority of the taxpayers are in favor of that sort of "extravagance." They have done more than vote on this question, for they have bought 25 million cars, and their money talks more loudly than any vote. Having thus expressed their desire as to motor-vehicle ownership, it follows inevitably that they have expressed their desire for suitable highways over which to run the cars. The slow but steady increase in the average rate of the gasoline tax, which now is 12 to 15 per cent of the retail selling price, shows the willingness of the public to foot the bill for better highways. In but one state is a large part of the gasoline tax diverted to uses other than road building and maintenance, and in that state a political fight is on to cease the diversion.

We are nearing the last lap of 1930, with road construction booming as never before, and with bright prospects that 1931 will break the 1930 record as decisively as 1930 has broken the record of 1929.

First Steps Taken Toward Securing a Highway from Alaska to Panama

PRESIDENT HOOVER has appointed a commission to determine the approximate cost of a road from Puget Sound to Alaska. The Canadian and American governments should share the cost of building that highway, for both countries would derive considerable benefit from its construction.

Since nearly all of the route would lie in British Columbia, a question would arise as to how America could assist in financing the project. Assuming, for the sake of illustration, that the construction cost were to be shared equally by Canada and America, it would be feasible to issue Canadian bonds for its full cost, under a contract with America guaranteeing an annual payment sufficient to cover the interest on half the bond issue and to amortize that half in, say, 50 years.

In order to meet the interest and amortization charges, at least in part, we suggest that a gasoline tax of, say, 5 ct. a gallon, be levied on all gasoline sold by filling stations along the route and within, say, 50 miles of the road, except stations within about 50 miles of Vancouver, B. C. We believe that the automobile traffic along such a great scenic highway would soon become great enough to yield an income from the gasoline tax sufficient to take care of bond interest and amortization and to maintain the road.

The British Columbia coast is one of remarkable beauty, and it is at the same time a veritable paradise for sportsmen. Its numberless rivers and creeks are filled with trout and salmon. Its forests are the abode of wild game. This is enough to attract thousands of tourists at certain seasons, and coincidently to assist greatly in the settling of this magnificent stretch of country.

America will soon be engaged in building another great canal between the two oceans, the Nicaragua canal. A coastal highway from San Diego, Calif., to the American territories in Panama and Nicaragua, is almost as much to be desired as one from Blaine, Wash., to Alaska. By financially cooperating with the governments of Mexico and Central America, such a highway can probably be secured.

It is not too much to hope that within the next decade a paved road will extend, unbroken, from the Gulf of Alaska to the Gulf of Panama. For more than 25 years such a highway has been the dream of a few road enthusiasts. At last the first important step leading to the realization of that dream has been taken. The recent appointment of an American commission to investigate the project of a highway to Alaska is that step. A few weeks ago a self-appointed "committee" of California motorists made a trip along the almost roadless coast of western Mexico, with the object of arousing interest in the proposed road to Panama. The trip admirably served its purpose. It is to be hoped that President Hoover will soon appoint a commission to survey that route, acting in cooperation with representatives of the governments of Mexico and Central America.

The dreamers have dreamed, and by their dreams have aroused a desire to act. Now let the engineers and builders have an opportunity to convert those great visions into greater realities.

A Plan for Converting Vacant Lots Into Playgrounds

OF the pedestrians injured or killed by motor vehicles in 1929, one in five was "playing in the street." This is based on analysis of accidents to about 87,000 pedestrians, and while this total is only about one-tenth of the entire number of injured pedestrians it is probably typical of the other nine-tenths. If so, about 170,000 children are injured or killed in America every year as a result of their using city streets for playgrounds.

It is almost useless to caution against, or even to forbid, the use of streets for this purpose, unless a convenient substitute is provided. We urge, therefore, the conversion of a large number of vacant lots into playgrounds. Nearly every city contains sufficient unused ground to provide adequate playgrounds for all the children who now use the streets. School playgrounds are not close enough to all the homes, and there is, moreover, a rather natural desire on the part of youngsters to play elsewhere than near the schools. Park playgrounds are even more inconvenient of access. Home yards are seldom large enough, besides, parents often object to the noise caused by a crowd of boys or girls.

The recent spread of the golf-bug epidemic has led to the building of more than 300 miniature links in Los Angeles, and as many more will soon be in operation there. Almost without exception these links are on lots hitherto vacant, and profitable only to collectors of tin cans. It has been a revelation to witness the transformation of hundreds of vacant lots into attractive little golf courses. At night under the illumination of powerful incandescent lamps, these courses are even more attractive than in the daytime. It costs several thousand dollars to build one of these miniature links, but for a fraction of such a cost a vacant lot can usually be graded, graveled, rolled and lighted, thus providing playgrounds where all the ordinary games of youth can be enjoyed.

As compensation to the owner, exemption from taxation would ordinarily be the only rental involved in acquiring the right to use the ground. As compensation to society there would be the saving of several thousand lives annually. Parents would be relieved of much of the worry over possible accidents. Children would get more fun out of life, and at far less risk of suddenly ending a life of fun.

H. P. Gillette

Heralding "County and Township Roads"

INTERPRETING the trend of events, "keeping step with the times," as it were, causes ROADS AND STREETS to dedicate a section of the magazine to county and township road work. With this issue we start discussing problems that are important to county and township officials. We recognize the fact that county roads must be improved to the point where all-season travel is possible if the people are to get the value out of the primary road system as has been calculated they should.

County officials are asking state legislatures for a more equitable distribution of the gas tax. They believe that a fair portion of this justifiable, acceptable tax should revert to the counties for secondary road construction. Much of the traffic, which pays this tax, originates and travels over the county road systems. A sizeable portion of it originates in cities and towns but quickly branches off on to the county road system.

The American Road Builders' Association, likewise recognizing the public demand for all-season roads on the secondary systems, has recently placed the County Highway Officials' division under the full-time direction of an experienced, seasoned ex-county engineer. For some years ROADS AND STREETS has followed this growing sentiment. In fact, last March we started out to publish a separate magazine devoted exclusively to county and township road problems. A close investigation of the feasibility of publishing a magazine which would be controlled to circulate only among county and township officials, technical men and superintendents brought to light some interesting information. This method of reaching them with discussions of secondary road problems has been chosen only after the most careful consideration of all these cognate data.

In order to serve more efficiently as a leader of county and township road thought and policy we earnestly solicit the cooperation of those engineers, superintendents and officials interested in the development of these secondary systems. We hope you will present your views, plans and ideas to us so we can publish them for the benefit of others. Let this section of ROADS AND STREETS be your forum.

The articles to appear in this section will be non-technical, pictorial and popularized. It is intended that they shall be so written as to convey to the elective lay official sufficient information on secondary road construction, maintenance, design and finance that he can keep abreast of developments and posted on changing conditions. County road problems, highway tax questions, traffic matters and the various and sundry controversial points with which local highway authorities have to contend should be put in writing by them and sent to us so that persons in other places may benefit by their experiences.

T. J. Rowse

County and Township Roads

Planning County Roads

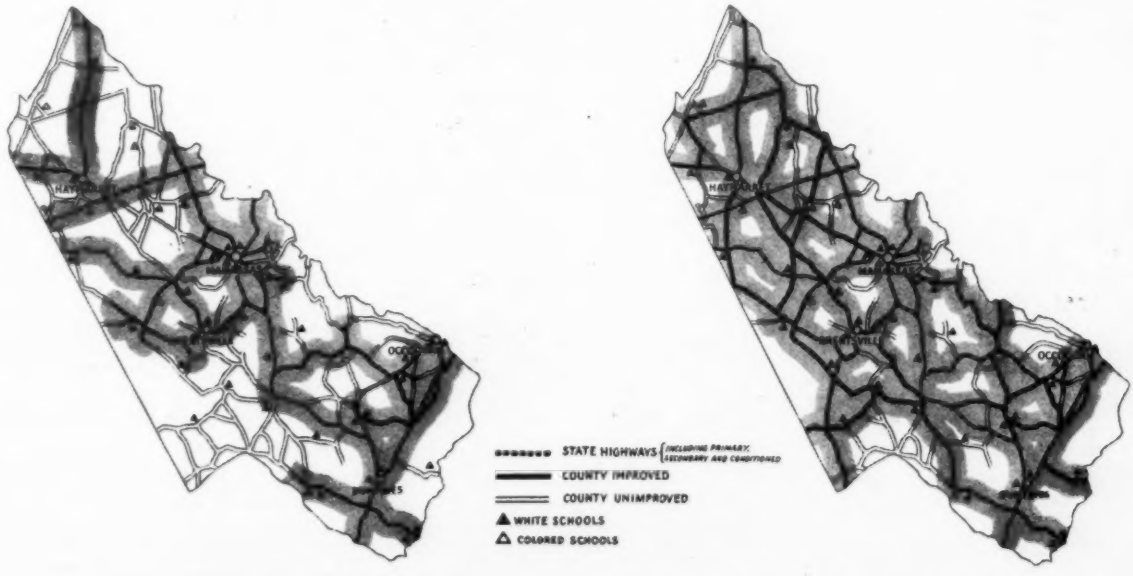
By NORMAN M. BLANEY

Director, Farm-to-Market Road Department, American Farm Bureau Federation

A GREAT deal has been written about the economics of roads, about the advantages obtained by road improvement, about the detrimental effect of poor roads and about the cost of various types of roads. But one topic has been neglected. One topic has not been discussed to as great length. Not much has been said about the necessity of drawing up, in advance of operations, a road-building plan for the entire county.

Importance of Planning.—It is well known and readily accepted that no one would care to consider or deal with a builder who did not start out with a full and complete plan for his project. Take, for example, the manufacturer who decides to expand his market. First of all he will outline a plan of action, taking all the factors into consideration, such as advertising, sales helps, demonstrations, publicity, etc. He will figure the cost of each and the total cost. He will decide which section of the country will give him the best results. He will decide the order of importance of the various factors. Knowing these factors and knowing the amount of the funds available for the work, he can fit the one to the other so that the whole will be taken care of in such a manner as will render the best service and assure the maximum return on the investment.

Suppose, now, that all the appropriated money should



Benefits of Planning: a Study of Prince William County, Va.

(Used with permission of Highway Engineering Bureau, Washington, D. C.)

Results of a survey of Prince William County, Va., of the type described by Mr. Blaney, are shown in the maps above. This county has an area of 345 square miles or 220,800 acres. The 1930 population is estimated at 15,000—an increase from 11,112 in 1900. The five towns range in population from 100 to 1,500. The estimated density of population is 43.5 per square mile. Principal agricultural products are corn, wheat, clover and timothy, with some fruits, vegetables, beef and dairy products. The total tax value in 1928 was $5,267,342.

Before Survey

The road system before the application of a survey is shown in the map at the left. There are 900 miles of road, or 2.61 miles per square mile of area. Of the 1,000 farms, 600 are on unimproved dirt roads. The greater part of the mileage consists of narrow, poorly drained, poorly located dirt roads. Some of the state roads are not passable at all seasons, on account of construction and other reasons. The 1928 expenditure for roads was $43,000. On the present basis, 14 years are required to complete the primary system, from 2 to 3 miles a year being built at first, up to 14 and 15 at the end of the program. The present tax rate of the county is $1.75 per $100 assessed value.

After Survey

A road system based on a comprehensive survey is shown in the map at the right. There are 444 miles of road, or 1.17 miles per square mile of area. The roads have been arranged to facilitate the maketing of products. Eighty per cent of the total area is within 1 mile of an all-year road. The program, costing $500,000, requires five years for completion. The maximum road-tax increase is 19.7 ct. (beginning, 1935; peak, 1942).

"For more effective improvement of county and township roads, the principal need is a plan which will restrict expenditures over a period of years to those roads which will serve the greatest number of people. Working under such a plan with adequate engineering supervision of local expenditures the present scale of revenue will produce decidedly more satisfactory results. The successful improvement of the main roads is the result of the adoption of just such a plan by the states. There is every reason to suppose that its adoption by local authorities will be followed by equally satisfactory results."—*Thomas H. MacDonald, Chief, U. S. Bureau of Public Roads.*

be expended on, let us say, the advertising and no allowance made for the sales assistance, or vice versa. Naturally the plan would not be complete, nor would the greatest benefit result. In other words, from beginning to end of the campaign, all the factors must be considered.

Many readers of this article are familiar with the problem of draining marshes or other swampy areas. You will grant, I am sure, that the most economical and the most efficient drainage system is the one which will drain the entire area. Certainly it would be false economy to expend the entire sum available on a main drain, which, because it will carry off the greatest quantity of water, will need to be the largest, and will therefore cost the most. The objective—draining of the whole field—would not be accomplished without the lateral or secondary drains.

The instances when one solitary drain will remove the water from any given area are few. They are, however, no fewer than the instances when a single improved road will serve the entire community. Yet this illogical, haphazard manner of procedure is the one used in many counties. It is not unheard of to see practically all the available funds being spent on one stretch of road. It is argued that by doing so and adding to it each year a superior type is obtained. Try to fancy someone with a need for a $10,000 house and a fund of $1,000 per year to build it. The first year the cellar would be constructed; the second year one of the main floor rooms; another will be added the following year. The tenth year the roof will be finished.

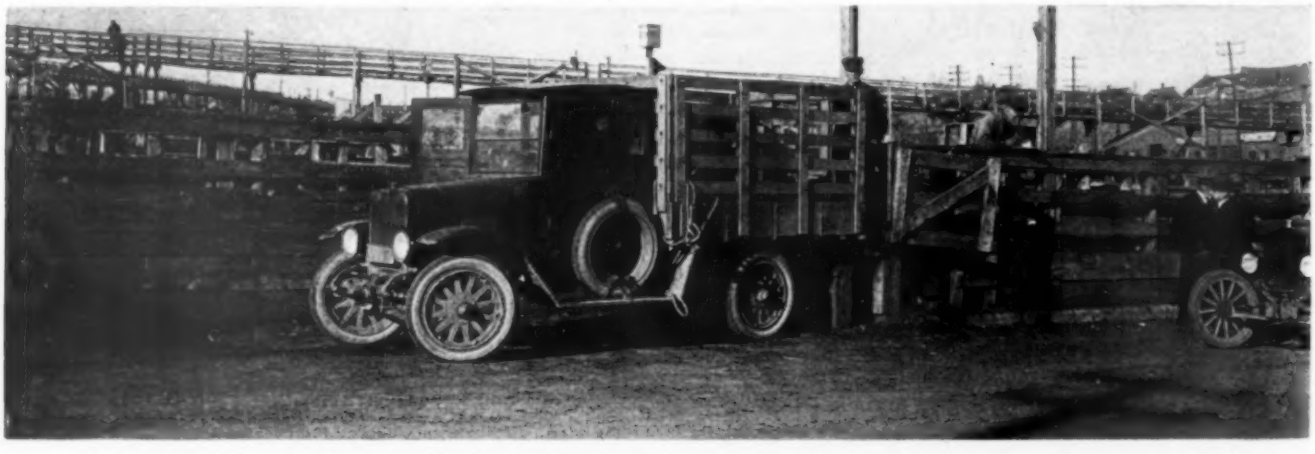
Survey First Step.—Now that main highway systems are being cared for by Federal and state authorities, it remains the duty of the county administrators to assume responsibility for providing means of access to that system, as well as a system of highways for the transportation of merchandise and population within county boundaries. This can be accomplished by a progressive plan, based on a survey of the county, its present facilities and requirements. The survey must precede all other activity towards highway construction and must take into consideration even the least-used piece of road. Such a survey is not necessarily a costly undertaking; in fact, the cost will be found quite justifiable and a many-fold saving effected by the carrving out of the plan or program which will be subsequent to it.

The factors which must be known are not numerous. The more important ones are population and its distribution, products grown and manufactured (classified according to kind, how and when marketed or shipped and type of vehicle used in marketing or shipping), vehicle registration (distribution, kind, use) and future growth and development (whether the county is continuing as a rural county or becoming urban; if the latter, whether its growth is centering in one or two large cities or in several smaller ones).

From such a survey, modified, if need be, to include whatever extraordinary pecularities exist, the road requirements may be set down. Traffic counts may be necessary to supplement the information. Consideration of traffic counts alone is not sufficient, however. Improvement made on a road leading to any given point will cause traffic to center on the road, in preference even to a shorter route if the latter is not in as good condition as the former.

Road Information.—After the survey is completed, information may be obtained from the state highway department or the U. S. Bureau of Public Roads, or both, as to the various types of roads which have been built in other localities, together with their approximate construction and maintenance costs and the amount of traffic each can be expected to carry under average or normal conditions.

It should be realized that it is no more economical



Unloading Live Stock at the Yards. This Truck Has Come a Long Distance Over Improved Roads

to build or consider only one type of road than it is to buy only one size of motor truck or only one type or style of clothes. Many experiments have been made and many different types of roads have been built by the road departments of Federal, state and county governments. A study of these will make it possible to choose the type which will prove the most economical and yet provide adequate facilities for the traffic requirements.

Absolute costs cannot be definitely stated. Nor can it be expected that information can be had which will be positive in recommending any one or more type to suit all conditions of climate, soil, traffic and finances. Nevertheless, with a knowledge of the traffic needs and a knowledge of the various types of roads which have been built and are proving economical in other sections, supplemented by a knowledge of the finances available and of what road building materials are to be found locally, a plan can be evolved which, when carried out, will assure the maximum economy and which will provide roads, not only adequate for present requirements, but of such a nature as will allow future improvement with the least loss of capital investment.

Poultry Raisers, as Well as Dairy Farmers and Grain, Live-Stock and Other Producers, Benefit by Well-Planned County Roads

Trunk and Tributary Roads.—Main-line railroads, main drainage pipes and main-line or trunk-line highways are essential in any scheme of such things, but the railroad will not show as great returns, the main drainage ditch will not prove as beneficial nor the main trunk highway perform its maximum duty without the branches or tributaries.

To construct roads which connect one state to another—the entrance and exit roads—is provided for, or such provision is intended by the Federal-aid road act. To provide roads which are exits from and entrances to each county within the state itself is the objective of the state highway department of the state in question. The county, therefore, should not be called upon to concern itself with any roads falling within either of these categories. Its interest should lie in providing roads which will permit the products grown and manufactured within the confines of the county, to be transported in the most economical manner to the market place or shipping point within the county, and to the inter-county road, if shipment is made by truck or wagon to a point outside the county.

The value of the road must be determined by the value of the travel or income which it carries, in ratio to the total travel-value or income of all the roads in the community. Thus it may be seen that a road leading into a town or city over which is transported products which provide labor for men and business for merchants is of more value to that town or city than another road which does not bring in as much business.

The writer can recall a particular instance in which certain residents within a certain city became rather vehement in their criticism of the farmers in that territory because the latter objected to another road being built through their properties on which they would have been taxed to no small degree.

The road in question would have reduced the distance to a large neighboring city by approximately 5 miles. The merchants in the large city were naturally in favor of the road. It would be more convenient for prospective purchasers to reach their stores. Peculiarly enough, the merchants in the smaller city were also in favor of this addition to the ease with which their legitimate customers could buy in the other city. Yet in the same breath they were deploring the fact that their customers were actually doing just that.

The farmers in question were informed that they would benefit by the increased values of their properties. If this increase in value were to mean an increase in income, undoubtedly the farmers would have been favorable to the proposition. The facts of the case, however, are to the contrary. An increase in value of farm land, with the subsequent increase in assessment value, unless it is accompanied by a corresponding decrease in the tax rate (which seldom, if ever, occurs), invariably means an increase in taxes and hence reduction in net income. Nor can it be shown that the farmer would save sufficient in cost of transport operation over another less costly but still adequate road to pay this increase.

No one who has made any material study of the economics of roads would attempt to show the lack of necessity for trunk or main highways. As has been stated previously, they are and always will be the backbone of the vehicular transportation system. However, it is not a difficult matter to show where they are not as economical as they would be if the vehicle owners are forced to pay twice the vehicle operation cost on the poorly constructed tributary roads which lead onto the main highway.

Basic Planning Data.—And now a word about obtaining the information on which any intelligently planned county road system must be based. There are, in almost every county, organizations which will assist in obtaining the necessary information. Each and all are vitally interested in the welfare of their community.

This 3-Ton Truck Owned by the Holmes County, Ohio, Farm Bureau Service Co., Makes Five Trips a Week 75 Miles to Market, or an Average of 1,000 Miles Including Pick-Up Hauling. A Typical Load Consisted of 28 Calves Averaging 145 Lb., 2 Hogs Averaging 500 Lb., 10 Hogs Averaging 200 Lb., and 2 Hogs Averaging 100 Lb.

Their members are taxpayers and will be willing to help any movement for the advancement of the county.

The automobile and motor truck registration, the population distribution and the available income may be found from the official records. The trend and type of growth can be ascertained from a review of the past.

The information needed regarding the manufactured and industrial production and the systems of distribution used in marketing can be obtained through the various chambers of commerce or similar associations.

The information regarding agriculture can be obtained through the county agricultural organization. In 1,837 counties scattered through 45 states the American Farm Bureau Federation, with which I am associated, has set up county farm bureaus.

Work of the A. F. B. F.—The American Farm Bureau Federation is most keenly interested in every movement for the advance of agriculture. Transportation is vital to the success of every farmer. For that reason the farm bureau has thrown the full weight of all the prestige and authority it may possess, to promote the cause of improved farm-to-market highways. Since Jan. 1 of this year we have been working to organize in every one of the 1,837 county units of the federation a county road planning committee. Membership in the farm bureau includes the most progressive farmers in the community, the men who are working out solutions to the problems peculiar to their business. They are tackling the problem of equalizing their tax burdens, of improving their schools, of lowering the cost of producing a unit of the produce of their fields, of finding ways and means to get better prices for this produce.

They have been trained to work together on all these matters of common interest to their calling. Now they are uniting to work on the county road planning project. In each county unit of the organization there has been appointed or will shortly be appointed a farm-to-market road committee whose intention it will be to work closely with the local government authorities, the highway engineers, the finance officials and all others directly responsible for the administration of highway funds. It will be their duty to assist the officials in designing an intelligent and economical system of roads, without regard to political expediency but definitely drawn to fit local requirements, and to be built on a long-time program.

In addition to the county committees, state committees will be organized through the state farm bureau office in each state, to centralize and head up the work of the county committees and to work with the farm-to-market department of the national organization, the American Farm Bureau Federation.

I do not know when there has been greater necessity for intelligent group action by public-spirited leaders to control the expenditure of road building funds. It has been the policy of the American Farm Bureau Federation and all of its branches since they were created, to take the lead in all projects affecting the welfare of rural America. For this reason the organization has embarked on this ambitious project and is making an effort to see that the greatest possible benefits are secured for the people most affected, from the vast sums available for highway construction.

Our road planning committees in 1,837 counties will be found willing to confer with and render valuable assistance to county officials in performing any work which has the advancement of their county as its motive.

Let the farm bureau help you get your facts together; then call in the highway engineer, the county treasurer, the auditor and sufficient representation from whatever other civic organizations may be interested, and evolve a plan which will be the best for both user and taxpayer.

Facts and finance are all that need to be considered. When road building is based on these and these alone, a new day will have dawned for those who must use and pay for the highways of America.

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Virgin Gold Used to Build Highway

One of the strangest and most expensive highways in the world is a 5-mile stretch in the southern part of Colorado. It contains $15,000 worth of virgin gold, $3,000 worth for every mile.

The precious metal found its resting place when the crushed rock for the cement mix was shipped from the ore dumps of the Cripple Creek gold field. The gold in this material assayed $1.50 to the ton, and 2,000 tons were used for each mile of the highway.

By C. N. CONNER
Associate Editor

Equipment Employed in the Construction of Mixed-in-Place Low-Cost Roads. This Is a General View of the Whole Outfit

Bituminous Surfaces for Light-Traffic Highways

IN the past and up to the present time bituminous surface treatments have received casual and passing attention by various associations, highway engineers and a few committees; but their importance has been submerged in the scramble to investigate and build high-type pavements. The time has come when this situation is being reversed by the growing demand for the farm-to-market road; this road is the low-cost, bituminous-treated surface.

Demand for Surface Treatment.—The surface treatment field has grown and the demand for surface treatments is still insistent. Thousands of miles of gravel and other low-cost types were needing surface treatments a year ago and still do; thousands of miles of untreated surfaces were added to that total during the present year. More than one-third of the states, which comprise more than one-half of the area of the United States, and literally hundreds of counties need definite, concise information on how to reduce dust, pot holes, corrugations and the loss of surfacing aggregates on their existing mileages of untreated roadway surfaces.

Unfortunately in many instances those highway organizations which control long mileages of light-traffic roads suitable for surface treatment, and which each year are increasing their mileage of untreated surfaces, are poorly prepared to make field experiments and laboratory tests; they must, for a time at least, depend upon other sources of information. What highway organizations have done to improve concrete roads can be done to improve bituminous surface treatments and other types of light-traffic surfaces.

An immense amount of study, research and promotion in the past ten years has not only greatly increased the mileage of portland cement concrete pavement but has also greatly improved its design and lowered its cost; this is an example of what can be done in the bituminous surface treatment field. It is a challenge to highway engineers. The low-cost road with a bituminous surface treatment is with us, it has come to stay and a way must be found to make its presence more profitable and useful.

Utility of Bituminous Treatment.—Bituminous surface treatments are profitable and for the following reasons:

1. They eliminate dust and add to the comfort and safety of the motorist as well as to the comfort of residents along the highway.

2. They conserve road-building aggregates. The cost to replace aggregate lost from untreated surfaces frequently ranges from $400 to $1,500 per mile per year.

3. They reduce maintenance and vehicle operating costs. When the economical limit of 500 to 600 cars per day has been passed on gravel roads, statistics show that these same gravel roads with bituminous treatment could carry 1,500 vehicles per day without signs of distress. A properly built and maintained bituminous surface treatment will in all probability show a saving in vehicle operation costs comparable at least with pavements.

4. They present on the average a better riding surface than untreated types which are not regularly bladed or dragged, and some of them have better riding surfaces than pavements.

5. They will provide a substantial and waterproof foundation for a pavement.

Factors to Be Considered.—Some of the factors

"What highway organizations have done to improve concrete roads can be done to improve bituminous surface treatments and other types of light-traffic surfaces."

"The low-cost road with a bituminous surface treatment is with us, it has come to stay and a way must be found to make its presence more profitable and useful."

which must be considered in connection with bituminous surface treatments are the following:

1. *Traffic:* The character of the present traffic must be known and that of the future anticipated. Sufficient information on methods of making simple traffic surveys has been developed. They include traffic counts and studies of trends in population, vehicle registration and agricultural and industrial developments.

2. *Aggregate:* A study of the road to be treated must be made in order to determine its reaction under past traffic, weather and soil conditions. This study is most important. Frequent examples can be cited where roadway aggregates unsuitable for treatment have been made suitable for successful surface treatments by the addition of sand, gravel, stone or slag. A mechanical sieve analysis of the materials in the road will sometimes indicate whether or not they are suitable for treatment. In some instances they are suitable; in others, new aggregate of similar material or a better material must be added before a satisfactory surface treatment can be insured.

3. *Bitumen:* Here is a real problem. There are on the market cold liquid asphalts, cold liquid tars, cut-back asphalts, asphalts and tars applied hot, emulsions, so-called road oils and others. These are general names. For each one of these general names there are still other names and a variety of specifications for each. How can the average road engineer (to say nothing of his laymen commissioners) find daylight in this maze? Some of these bitumens are good, and some are excellent surfacing binders; some engineers and some producers know which are the best for treating a specific type of road aggregate; but there are many who do not know nor can they readily obtain the specific and accurate information which they sorely need.

The remedy is to get down to fundamentals, get engineers in industry and out of it to agree on specifications for materials and construction methods. Then it will be the producers' part to furnish consistently these bitumens as specified. The producers can and will do this thing when they fully realize the possibilities for new business in the bituminous surface treatment field and when highway engineers become agreed on simplified practices in this field.

4. *Equipment and Construction Methods:* In this discussion reference is made to bituminous surface treatment types which cost less than $5,000 per mile for an 18-ft. width. This automatically excludes bituminous penetration macadam and the majority of pre-mixed types, which seldom cost less than $8,000 per mile. There remain, therefore, the surface-application types and the mixed-in-place types.

In the surface-application type there is a tendency toward mechanical equipment for spreading aggregates, and the use of drags for smoothing out the aggregates after they are spread. The mixed-in-place type, which is newer, is growing in popularity to include some of the more conservative states as well as those which were pioneers in its development. Mechanical equipment for this type is necessary. Road bladers and drags are the principal tools. Distributors and power rollers have been found desirable equipment for both types.

Tendencies.—1. The partial or total failure of up to 20 per cent of a bituminous surface treated project at the end of the first year does not spell defeat to highway engineers who are experienced in surface treatments on secondary roads. Each succeeding year the weak places are corrected until the total failures for any one year reach a relatively low percentage.

2. Smooth riding surfaces are becoming the rule rather than the exception.

3. Wide roadway sections of more than 18 ft. are becoming more popular; they tend to reduce traffic concentrations, edge failure, maintenance costs and accidents.

4. Low crowns of ¼ in. to the foot are almost universally recognized as the best practice by engineers who know.

5. Coarse, clean crushed aggregate is preferred for the heavy hot applications of bitumen.

6. Bituminous subgrade treatments for gravel roads have given good results in Minnesota, and there is reason to believe that bituminous subgrade treatments are desirable for other types including pavements.

In addition to the foregoing, there are two outstanding facts:

1. The bituminous surface treatment field offers a wonderful opportunity for producers to increase their output of bitumens at a profit and for owners to improve their light-traffic road mileage at a low cost.

2. Good results generally in the construction and maintenance of bituminous surface treated roads will come when the best of existing knowledge has been molded into standard, simplified practice.

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Illinois County Builds Roads of Bituminous-Bound Large Gravel

Bituminous-bound roads constructed with large gravel in Du Page County, Ill., have been attracting national attention, according to E. L. Gates, superintendent of highways, Wheaton, Ill.

In making a gravel road 20 ft. wide, about 4,000 cu. yd. of gravel are used to the mile; this costs 50 ct. per cu. yd. in the pit. Loading costs 20 ct. per cu. yd.; hauling costs 50 ct. per yd. for the first mile of haul and 10 ct. for each additional mile. On a 2-mile haul this would make a cost of $1.30 per cu. yd., or $5,200 per mile.

The following costs apply to the top course, which is known as No. 9 clean washed gravel, or gravel passing a 2-in. ring and retained on a 1½-in. ring: $1 per cu. yd. at the pit, 20 ct. for loading, 50 ct. for the first mile of haul and 10 ct. for each additional mile. The voids are filled and the surface is covered with pea gravel; this is figured as 4 in. thick, including the pea gravel. The cost for a 2-mile haul is $1.80 per cu. yd.; using 1,200 cu. yd. to the mile, the cost per mile is $2,160.

Tar or asphalt spread on the road costs approximately 14 ct. a gal. This is applied at the rate of about 2 gal. per sq. yd., making a cost of about $3,000 for a mile of 18-ft. road. This makes a total cost for the bituminous course of approximately $5,000 a mile. As the base course is about the same, the total cost of the road with a good 12-in. base and a 3-in. top is approximately $10,000 a mile. There are a good many places where such heavy construction would not be necessary and the base could be cut to 6 or 7 in. with a 3-in. top, giving a good road for approximately 800 to 1,000 vehicles a day.

County Road in Gratiot County, Mich., Ready for Oil

Solving the MARKET ROAD PROBLEM

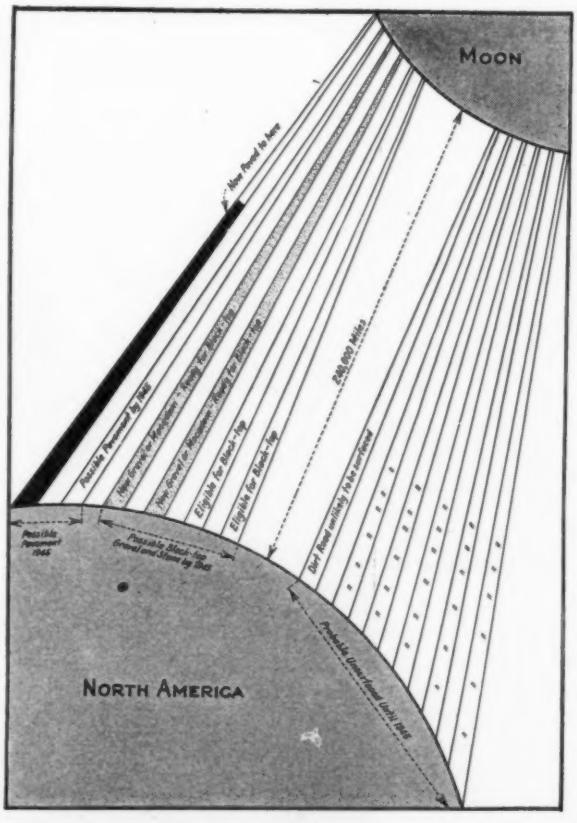
How one Michigan county satisfies the taxpayers' demands for adequate middle-class roads at reasonable cost

By JOE L. LONG
Associate Editor

THERE is enough public highway in the United States to reach from here to the moon twelve times and leave a substantial surplus. If a straight road reached from your home to the moon and you started to drive there, traveling 60 miles per hour, 24 hours a day, you would be 5 months and 17 days covering the 240,000-mile distance.

Our concrete, brick and bituminous macadam highways of the higher types will cover considerably less than one of these dozen laps, and it is reasonable to assume that within the next fifteen years this total of Class A rural highways might reach the enormous total of two laps or 480,000 miles. It is likely to be much less but it is a good high mark to shoot at anyhow. As to the other ten laps, I should say that one can safely assume that six laps or about 1,500,000 miles are of such character and location as to be unlikely, during the same period, to get beyond a reasonably safe dirt road.

Four of these laps between the earth and moon, or about 1,000,000 miles, can be roughly classed as those roads that are of sufficient importance to justify an expenditure of $3,000 to $10,000 per mile to make them serviceable and efficient for all-year-around travel. They cannot reasonably be considered eligible for $20,000 to $40,000-per-mile pavements. Before discussing the possible and, in my opinion, quite feasible treatment of this vast mileage of secondary highways I want to say a word or two about highway building in general.



Present and Probable Future Road Mileages

Development of Highways.—Many people have asked me, during the twenty years I have been more or less active in highway development programs, why the United States was so slow in getting started in road building as compared to France, England, Germany, Austria and some other European countries. The answer was that the question assumed facts that were entirely false, as do many questions we ask about public affairs. Early in the nineteenth century our young nation began road building on an enormous scale, mostly, however, with private capital and supported by payment of tolls. In Pennsylvania alone over 2,000 miles of stone roads or pikes were built between 1800 and 1810 and the total of such

roads was very large. The Federal government took a hand and had spent many millions on the great Cumberland Pike, planned to connect the Mississippi River at St. Louis with the tidewater of the Atlantic (and actually completed as far west as Ohio), when a new type of road far better than any previously built was discovered.

It was found that by laying two steel rails parallel and using a vehicle that fitted this roadway, freight and passengers could be moved at greater speeds and less cost than over any other type of highway. With all the energy and enthusiasm of a young nation America turned to the building of this new and wonderful type of main road and in fifty years built five times the mileage of iron roads that Rome built of stone roads in that much heralded system that centered at the Eternal City and on which millions of slaves labored for two or three centuries.

These railroads were just stone pikes with a college education and it was quite natural that, while the resources of the entire nation were being pledged in order to complete these new trunk lines from ocean to ocean,

Above—Spread after First Application; Ready for Second

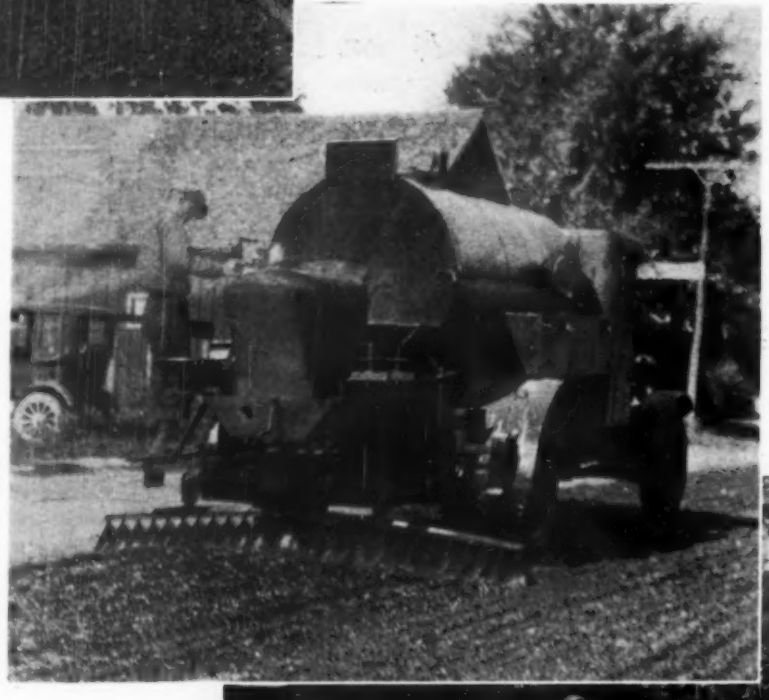
gridironing the whole country, we should have done but little on the wagon roads, the apparent function of which was to provide means of reaching the nearest railroad station.

Then the internal combustion engine and the automobile changed the function of the wagon road and a new era began. That is recent history and will not be repeated but no American need apologize to himself or others for our record in road building—a record that includes the construction of about one-half the iron roads of the world, the biggest single factor in the building of this great nation of prosperous and independent people. For twenty years we have been engaged in planning and building a trunk-line system of roads for motor traffic and now we are finding a major problem in the roads between "dirt" and "paving."

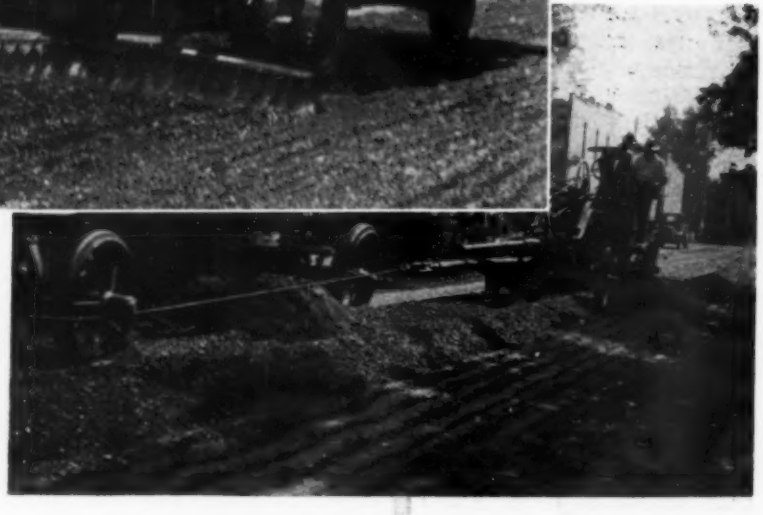
For this type of road, waterbound macadam and gravel have been quite widely used but the traction and suction of rapidly moving rubber-tired vehicles has made their maintenance heavy and their condition uncertain and variable. The use of bituminous materials to form a mat or binder has been quite extensive, and results obtained have varied quite as much as methods of use.

Experience of a Michigan County.—In the far west and lately in the middle west, these experiments have narrowed down to fairly well standardized construction and, without undertaking to discuss the relative merits of various retread surfaces, we want to describe the roads built last year in Gratiot County, Mich., at a cost of less than $3,000 per mile and which have attracted much attention in Michigan and neighboring states. The mile connecting North Star, a small town in the central part of the country, with the concrete trunk line was built in July, 1929. The roadbed had some gravel in it, rather on it. Its surface was shaped up and 880 yd. of gravel containing a large amount of fine aggregates was placed on it, giving a 3-in. coating 18 ft. wide. Three applications of No. 6 Standard road oil, each of ½ gal. to the square yard, were made with an Etnyre distributor owned by the county. This required about 9 hours. After each application the road was disked and then bladed to the full depth of the gravel.

Following the first two applications the materials were disked and then bladed to the center and back over the road once or twice. After the last application the mass was bladed to the center and then cut open and spread.



Left—Making Second Application of Oil



Right — Mixing the Materials in Place

Completed Road Open to Traffic

The operation was repeated for a total of eighteen movements altogether. The entire mass was then of uniform color. Two men with hand rakes and shovel patrolled the road during the mixing, raking out tufts of grass caught by the blades along the edges of the roadway and raking small spots that appeared too light in color. The entire mass was then spread evenly to a width of 18 ft. and a depth of approximately 3 in. and leveled off with an Adams maintainer. Traffic was turned on the road at once but the maintainer was sent over the road once a day for a week, after which not a cent's worth of maintenance work was done until spring, except snow removal. The road carries a moderately heavy traffic and its condition and appearance have received much favorable comment.

The writer saw the road built and examined it during the fall and again in March after the frost had gone out of the ground. There were two spots where water had seeped up through the surface but neither place broke through and the work of repairing was a matter of minutes. No one could have found a half-day's work on the entire mile. Another stretch of three miles of the same type was built in October by George Clow, county highway commissioner, on a heavily traveled road leading out of St. Louis, Mich., to the north. The roadbed here was not so well drained but after the winter had passed, but two spots, one on a hilltop in a cut and the other over a very springy spot without drainage, showed any signs of breaking up. In these two spots Mr. Clow planned to put in a drain of coarse gravel 18 in. deep and 12 in. wide. This work, which would have been done before surfacing but for lack of time due to lateness of the season, cost but a few dollars.

This year Gratiot County will build not less than 25 miles of this "turnover" type, as it is called in some localities, and several other counties in Michigan will build from 1 to 10 miles each.

This is one of the cheapest types of black-top roads that can be called construction work and is similar to many roads built in Wyoming, Montana, Colorado, California and other states where the cost per mile must be kept low. Montana has contracted nearly a hundred miles for this year at a cost for application of oil and "processing," which includes mixing the binder and aggregate and finishing the surface, of approximately $1,000 per mile. This is, of course, inclusive of oil and gravel, the latter being in place on the road when the contractor begins work. The state will build another hundred miles with their own equipment.

There are many splendid roads built with tar and asphalt binders and stone or gravel aggregates, in a wide range of specifications, throughout the middle west that offer practical proof that this middle-class road is coming into its own; and we only regret that we are limited to a specific example of what can be done to make a road of high efficiency and attractive appearance at a price this class of highway can afford.

It goes without saying that a "place for a road" or, in other words, a well drained grade is a prerequisite for any of these or any other types of surface and that the only "permanent" road work ever done is taking a shovel full of dirt from where you will never want it and placing it where you will always want it.

The work described above was done under the supervision of George Clow, county highway commissioner, assisted by W. H. Myers, of the asphalt department of the Standard Oil Co. and Herbert Dailey, of the Mid-West Refining Co., of Denver, Colo.

Essentials of a Good Black-Top Road.—There are just four factors that enter into a good black-top road. Of course we must always assume that a well drained and well settled grade has been built before any kind of surfacing material is applied. Then we must have:

1. A good metal aggregate.
2. A binder suited to the metal aggregate.
3. Even and thorough mixing.
4. A level surface.

As to the metal used, this may be either crushed stone or gravel. For the cheaper types where heavy oil is used, gravel should contain nothing larger than 1 in., and ¾ in. maximum is better. It is important that there be plenty of fine materials.

Where crushed stone is used specifications vary greatly and asphaltic or tar binders suitable to the material must be carefully selected.

As to the mixing or combining of metal and binder, accuracy of distribution is the primary necessity, and if it is to be mixed with blades, as in the so-called "turnover" method, this accuracy is even more vital to success than in the penetration process.

A level surface is essential, because if depressions are allowed to form traffic will pound them deeper with increasing distortion of surface. With reasonable attention given to these four factors there will be uniformly satisfactory roads to show for your efforts and without proper attention to any one of them, disappointment is unavoidable. The human element is not any greater than in most other types of public work and a clear and definite understanding of what must be done is the surest guarantee that it will be done right.

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New York was the first state to license motor vehicles, beginning in 1901, and collecting $954 that year.

BEFORE

One-lane roads over a poorly maintained surface invite accidents and discredit a community. This road in Independence Township, Warren County, N. J., is known locally as Alphane Road.

Old Chester and Welsh Road was a narrow county road in Essex County, N. J., which was all but obliterated by encroaching vegetation. It was a single-lane road which provided but a short sight ahead.

AFTER

Notice the difference between the road pictured above and that directly opposite. This shows what the judicious expenditure of a few dollars can do for the market road of a community.

By widening the Old Chester and Welsh Road and placing a penetration macadam surface upon it, it has been made safe for travel and has become the pride of the community.

The Road Builders' News

Publishers Promote Road Program Expansion

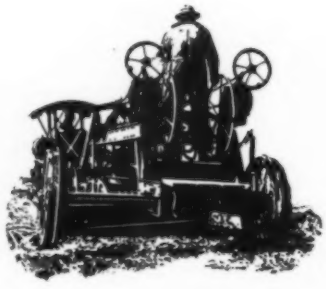
At a meeting of technical magazine publishers, called by W. A. Van Duzer, president of the American Road Builders' Association, held in Washington, D. C., on Aug. 2 to consider ways and means of expanding the road and street program, representatives of ten magazines were present and letters were received from most of the sixty other publications invited to participate in the meeting assuring the American Road Builders' Assocation of the fullest cooperation.

During the meeting the work of the A.R.B.A. was explained in detail to the publishers and definite avenues of release were offered by the publishers for the mass of research information they found accumulated in the files of the association and in process of collection. The work of eight research engineers who travel almost continually and are in touch with the latest developments, offers an excellent opportunity for obtaining up-to-date information for the use of magazines.

At the luncheon tendered the publishers at the Willard Hotel there was further discussion of the road show and convention to be held in St. Louis, Jan. 10 to 16, 1931, and fullest cooperation was offered by the publishers as a matter of mutual interest in developing the largest attendance and making it the most successful exhibition of machinery. Because of the central location of St. Louis and the large programs of construction in cities and states in the adjacent territory, an unusually large attendance is anticipated.

Machinery at International Road Congress

A striking portrayal of the evolution of road-building machinery in America will be presented to a world-wide gathering of road experts at the sixth International Road Congress held in Washington, D. C., Oct. 6-11, according to W. A. Van Duzer, president of the American Road Builders' Association, under the auspices of which the exposition of highway machinery and materials is to be given. With almost all available space taken both in the Washington auditorium and the outdoor demonstration field, the congress is



assured of a comprehensive exhibit of the newest and best highway equipment, Mr. Van Duzer declares.

A large educational exhibit of the U. S. Bureau of Public Roads illustrates the generally accepted practice in the new science of subgrade soils. Since scientific methods were first applied to these studies some 10 years ago, many phases of the subject have been explored, bringing to light information of immense value to the highway engineer. To hasten the adoption of the results already accomplished, there must come a general recognition of their value. The exhibit will illustrate how the isolated discoveries of investigators, both here and abroad, have been organized into a systematic and scientific method.

A luncheon tendered all delegates by the A. R. B. A. will precede the formal opening Oct. 7 of the exposition which, like the congress sessions, will deal with all phases of highway construction and maintenance, traffic and administration.

Exhibits will include tractors, scrapers, surfacers, motor graders, spraying machines, stone-crushing plants, hoisting engines, mixers and bins, electric tools, culvert pipe, road materials, motor patrols, traffic signals and signs and a host of others. Small models and motion pictures will be used where space limits exhibits of larger machinery, while many of the exhibitors will take advantage of the exceptional opportunities offered in the demonstration field.

"Some of the International Road Congress delegates," says Mr. Van Duzer, "will come from nations where primitive methods are still in use. They will learn here of the various steps in development from hand labor to stock-drawn mechanical equipment, then to speedier and more efficient machinery, brought about by the need for mass production of roads and by the advent of automotive power."

A. R. B. A. Exhibit at American Fair

There is being held in Atlantic City, N. J., from July 17 to Aug. 28, an exposition known as the American Fair. In view of the fact that organizations such as General Motors and similar concerns maintain a year-around exhibit on the board walk, the officials of the Atlantic City auditorium sponsored this exposition with the idea of attracting exhibits from the various industries for the period noted above, which is, of course, the season when the largest number of visitors are in the city.

The American Road Builders' Association has a booth representing the highway industry. The exhibit is educational, showing pictorially and graphically many phases of the road-building game. Standard signs and markers, highway finance, highway expenditures, development of transportation and other items of interest are dealt with. There are also on display models of the various types of paving showing the construction of each, as well as culverts, bridges and similar structures. These exhibits were obtained through the cooperation of the U. S. Bureau of Public Roads. The manufacturer members of the association have also furnished models of their equipment and materials, which are on display. Miniature blade graders, cranes, crushers, instruments, maintainers, rollers, scarifiers, spreaders, trucks, tractors and pieces of testing apparatus, as well as materials and accessories, are on exhibit.

The figures released by the auditorium management for the period from July 17 to 29 show an average daily attendance of more than 23,000. The booth is in charge of P. F. Seward, staff engineer of the American Road Builders' Association.

Roads by Radio

"The Romance of Road Building" was the title of a radio talk given Saturday evening, Aug. 2, by Charles M. Upham, engineer-director of the American Road Builders' Association, from the broadcasting studio of station WMAL in Washington, D. C.

The talk was carried over the entire Columbia system and many letters of congratulation have been received by Mr. Upham.

C. R. Thomas Accepts Direction of City Officials' Division

Reduced costs of city paving and standardization of street and traffic practices are the aims of the 1930 program of the City Officials' division of the American Road Builders' Association, according to C. R. Thomas, who has been appointed engineer-executive of the division.

Five general committees have undertaken a survey of 20 leading cities through personal study by investigators who will seek answers to questions brought up by committee members. The general subjects will be administration, organization and finance, design and construction, maintenance, traffic and airports. The work is being directed by the division president, Col. C. E. Myers, director of transit, Philadelphia, Pa.

On airports, a joint nation-wide study is under way through cooperation of the Department of Commerce, the American Enginering Council and the A.R.B.A. The division will await the results of this survey to secure the latest airport information.

Municipal highway finance, with special attention to assessment practices, will be studied by finance specialists from various cities under the leadership of Capt. H. C. Whitehurst, chief engineer coordinator, Washington, D. C. Another subject of special interest is highway resurfacing and widening, under the maintenance committee, headed by A. T. Rhodes, superintendent of streets and sewers, Leominster, Mass. Authorities hold that in many cases where traffic congestion exists, resurfacing and widening of existing streets and highways will solve the problem more quickly and economically than construction of new highways. Resurfacing of worn-out pavements and widening of streets to carry a greater traffic load results also in increased economy and safety to the motor car operator.

The important subjects of construction and design will be reported on by a committee under chairman George B. Sowers, deputy commissioner of engineering and construction, Cleveland, Ohio. The chairman of the active group investigating the ever-present problems of traffic in all its phases is M. O. Eldridge, assistant traffic director, Washington, D. C.

In his work as engineer-executive, Mr. Thomas will visit New York, Chicago, San Antonio, New Orleans, Houston, Oklahoma City, Milwaukee, Indianapolis, Louisville, Memphis, Des Moines and Kansas City.

To his new post Mr. Thomas brings a background of many years in the study, teaching and practice of highway engineering and in the highway magazine publishing field. He was for a time associated with the U. S. Bureau of Public Roads, has been a member of the teaching and research staffs of several colleges, is author of many bulletins and articles on engineering subjects and most recently was editor of *Highway Engineer and Contractor*.

"Present indications are that we will have a wealth of new and valuable information to present the great gathering of city officials next January at the annual convention and road show in St. Louis," Mr. Thomas declared.

Collecting Subgrade Data

To obtain actual first-hand information on the best paving practices now in use, James S. Burch, Jr., of the American Road Builders' Association engineering staff, Washington, D. C., is visiting leading city engineers throughout the middle west during the months of Augsut and September. Cities which Mr. Burch will visit are known to use good methods of constructing pavement bases and pavements for city streets, with special emphasis on the relation between subgrade conditions and the strength and thickness of the base.

Some of the items being studied are improving the subgrade, support, strength and thickness of bases, and the effect of wearing surfaces. The association, along with other active highway engineering organizations, is stressing the importance of subgrade soil study, a subject which has been given little attention in the previous years of development of road-building methods.

The information is sought for the report of the special subgrade and pavement bases committee composed of nationally known authorities on street and highway paving. The report will be a feature of the program of the 1931 convention of the American Road Builders' Association next January in St. Louis, and it should prove of the utmost value to all city engineers and officials interested in better streets at lessened costs.

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This section, devoted to the activities of the American Road Builders' Association, will be a regular monthly feature of ROADS AND STREETS

M. de Glopper Appointed Equipment Committee Chairman

President W. A. Van Duzer of the American Road Builders' Association has announced the appointment of M. de Glopper, materials and equipment engineer, Michigan State Highway Department, Lansing, Mich., as chairman of the highly important equipment committee.

This committee, which has done work of immense value to the road-building industry in previous years, will take up in this year's agenda, snow-removal equipment, standardization of purchasing methods, operation and development of traffic-control signals, power requirements for operation of various types of road machinery, survey of need for and availability of maintenance equipment, central and transit mix concrete equipment.

Chairman de Glopper will be assisted by sub-chairman in charge of the various investigations and the entire committee membership of highway industry leaders. The report will be prepared with the assistance of a headquarters staff investigator and will be presented at the annual convention and road show in St. Louis in January, 1931.

Road Show Announcements

Early in August the St. Louis road show announcements were mailed from Washington headquarters to a mailing list of 35,000 association members, state, city and county highway officials, contractors, engineers, manufacturers and publishers throughout the United States.

In black type, carried on a background of pictures of the 1930 road show in attractive shades of orange, the folders give much information on the convention city, the Highlands arena buildings, transportation arrangements, the road show exhibits, the convention program and the entertainment features, along with detailed hotel information with a blank on which hotel reservations may be made.

While St. Louis promises more than adequate hotel accommodations, those who plan to attend the 1931 road show from Jan. 10 to 16, 1931, are urged to make their hotel reservations early.

The St. Louis arena affords almost 250,000 sq. ft. of floor space and it is a foregone conclusion that it will be taxed to capacity with the exhibits of more than 400 manufacturers of road-building equipment and materials.

Recent Books

Drainage Theory and Practice

HANDBOOK OF CULVERT AND DRAINAGE PRACTICE, by Armco Culvert Manufacturers Association. First edition, 357 pages, 4½ in. by 7 in., flexible binding. Armco Culvert Manufacturers Association, Middletown, Ohio, publishers.

This pocket-size volume is a collection of information on present practice and theory in drainage, runoff and seepage. It is not confined to any one field but covers the employment of culverts under any condition where water is to be handled. The authors have cited their sources of information and have filled the pages with data and information that should prove helpful to many engineers as well as non-technical men. The solutions of some practical drainage problems have been presented here—as probably has not been done before within the covers of one book.

Following is a table of contents:

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Masonry Structures and Foundations

THE DESIGN OF MASONRY STRUCTURES AND FOUNDATIONS, by Clement C. Williams, C. E., dean of the College of Engineering, University of Iowa; member, Am. Soc. C. E.; member, A. R. E. A.; member, S. P. E. E. Second edition, 603 pages, 5¾ in. by 9 in., hard cloth binding. McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York, N. Y., publishers. Price, $5.00.

In this edition the new material includes a treatment of the improvements and developments that have occurred since publication of the first volume. The author has revised his method of presentation in some cases so that principles are more easily grasped. The more simple the presentation, the better will the theory be understood. Some of the old treatments of loads on dams, foundations and retaining walls are classic to the degree that they are confusing. An economic analysis does not require so much detail.

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The Duties of Inspectors

BYRNE'S INSPECTOR'S POCKET BOOK, revised by Samuel T. Goldsmith, instructor, City College of New York; associate member, Am. Soc. C. E. Fourth edition, 244 pages, 5 in. by 8 in., paper-cover stiff binding. Gillette Publishing Co., 221 E. 20th St., Chicago, Ill., distributor. Price, $3.00.

Inspectors on both public and private work are charged with the duty of enforcing the specifications. Sometimes they are men with technical training and experience but more often the reverse is true. The function of this small volume is to apprise those individuals of the duties of inspectors and tell them what to look for and what to avoid in construction of civil works so far as the enforcement of specifications and employment of materials is concerned.

The author plainly states that "it must be distinctly understood that the directions or suggestions set forth are not intended to run counter to, or to be employed in opposition to the directions and instructions given in the specifications under which the work is being prosecuted." The book presents in concise form (1) the duties of the inspector, (2) the characteristics and defects of the materials used in construction, (3) a description of the methods employed in preparing the materials for use, (4) the manner of placing the prepared materials in the structure and (5) an outline of the points to which the inspector must direct his especial attention to secure a faithful compliance.

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Ultimate Economy Point of View

PRINCIPLES OF ENGINEERING ECONOMY, by Eugene L. ing, Montana State College. 387 pages, 5¾ in. by 8⅛ in., hard cloth binding. The Ronald Press Co., 15 E. 26th St., New York, N. Y., publishers. Price, $3.75.

The refreshing analysis of this subject as made by the author makes the book exceedingly fascinating. At best the study of engineering economics is a dry subject unless one's own money is at stake. But this book is different. There has been, in the past, a noticeable lack of this knowledge on the part of engineering students entering the business world. Engineering economy is the transition subject between the purpose of business, which is that of making a profit, and the application of scientific principles to the employment of material things.

The method of treatment employed by the author is that of using specific examples to typify certain principles—a very commendable practice. Engineers are well adapted to determine the economic design or arrangement of material things but have seriously lacked a point of view on the economic employment of those things. The treatment employed in this book is that of standing off at a distance, observing the problem and then applying the correct principles for its ultimate solution.

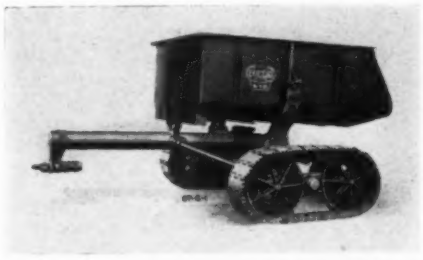
The following chapter headings show how the contents are treated:

Reading this volume has been a distinct pleasure. Concepts and ideas on engineering economic applications that were formerly hazy have become clearly defined.

New Equipment and Materials

Euclid Announces New Wagon

A late addition to the line of earth-moving equipment of the Euclid Crane & Hoist Co., Euclid, Ohio, is the gravity rear-end dump wagon shown in the accompanying illustration. Built on the Euclid "track-wheel" crawler-type chassis, it has been found excellent for



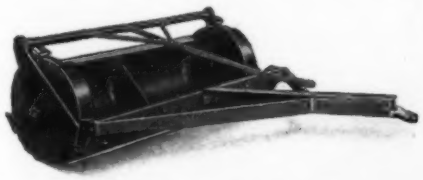
Euclid Gravity Rear-End Dump Wagon

work in rock, sticky clay or gumbo. It has a capacity of 6 cu. yd. and can be pulled easily by a Caterpillar 30 under adverse conditions. It is built in one size only, to operate on shovel work. It is operated by the tractor driver who, by giving a slight pull on a rope, releases a catch which permits the load to dump. The body rights itself automatically.

Rotary Scraper Offered by Adams

A rotary scraper is being offered by the J. D. Adams Co., Indianapolis, Ind., manufacturers of adjustable leaning wheel graders and other road equipment. This scraper can be hitched to any pull on the rope control by the tractor operator. It loads automatically, requiring no stopping or backing to reload, and fills, hauls and dumps with the tractor in continuous forward motion.

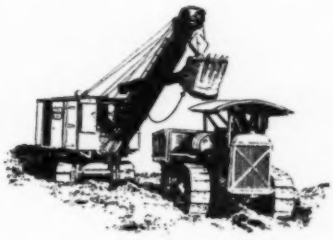
The scraper automatically stops digging when completely loaded and when pulled to the dump, requires only an upward pull on the rope control by the tractor operator to dump the material and spread it to the depth desired. It rides back in



New Adams Rotary Scraper

this dumping position. To start the scraper digging in, the tractor operator simply gives the rope control another pull and the scraper bowl rolls over into digging position.

The company claims that the scraper is unusually heavy with few working parts. Its simplicity of design is unusual, yet exceptional performance and dirt-moving capacity are claimed for it.

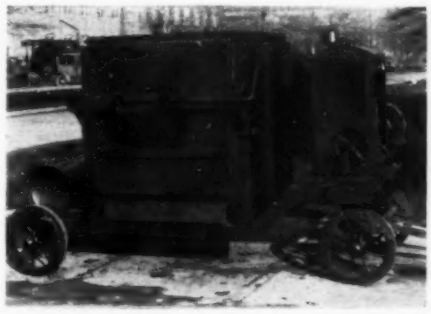


These scrapers come in eight different sizes from 12 to 70 cu. ft., for use behind tractors of 10 hp. drawbar and larger.

Chausse Sand Drier

A new type of portable sand drier or reheater for paving mixes has been announced by the Chausse Oil Burner Co., Elkhart, Ind. This machine has been developed to meet the necessity for rapid heating and drying of sand or stone for railway and contractors' uses, or for reheating pre-mixed and natural asphaltic paving repair materials.

It consists of a rotating drum with



Chausse Portable Sand Drier and Reheater

internal cascading blades, mounted on SKF self-aligning ball bearings and enclosed in a steel housing. The drum is turned by a LeRoi single-cylinder, 4-hp., radiator-cooled engine, with Twin Disc clutch and Cotta reducing gear, through a hardened roller chain.

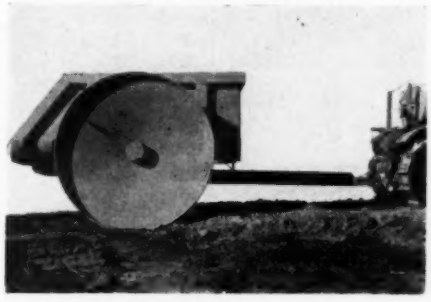
An important feature of this machine is the indirect application of heat. It is equipped with two Chausse self-generating kerosene burners, situated within the steel housing underneath the rotating drum. These apply the heat effectively on the outside of the drum and no high-temperature flame comes into contact with the drying or heating materials. This is especially valuable in handling bituminous mixes which can be very easily damaged in open flame-type heating. It is also important in drying certain mineral sands and aggregates which explode and turn to fine dust if too severely or highly heated.

The machine is mounted on rubber-tired steel wheels, with roller bearings, and has a steel towing tongue. Kerosene is stored in a 30-gal. welded steel tank and pressure is supplied by a 3-in. hand-operated air pump. Several sizes and capacities can be furnished.

A New Wagon

A new wagon, known as the Le Tourneau chariot-type dump cart, is shown in the accompanying illustration. It has been designed and perfected by R. G. Le Tourneau, Stockton, Calif., after several years of experience in building other wagons, both with track tread and wheels.

The cart is built of metal throughout,



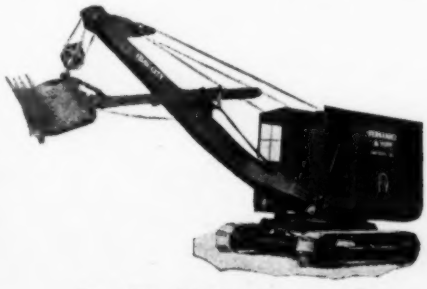
New Le Tourneau Wagon

and is rugged enough to stand rough treatment, weighing approximately 7 tons empty. It is easily dumped by means of a power control unit, operated by the tractor driver. No castings are used, the cart being entirely of electrically-welded plate steel. The operator has a clear vision underneath the axle and can dump in a pile or can spread out his load by backing up.

The axles are of 6-in. heat-treated alloy steel, and extra large Timken bearings are used. The wheels are 78 in. in diameter with a 30-in. face, which makes it possible to travel over nearly as soft a material as with tracks, the manufacturer states. The body is 9x11x4 ft., holding 12 yd. water level or 16 yd. heaped up.

Bay City Announces New Shovel

Bay City Shovels, Inc., Bay City, Mich., announces the Bay City K2, full ½-yd. (struck measure), full-revolving shovel as a companion to the Model



Bay City Model K2 Shovel

K light, ½-yd., full-revolving convertible shovel.

Both models will be continued in full production and there is no intention of abandoning the light, ½-yd. Model K. On the contrary, all of the features of design which have made this machine popular are offered in the K2, the prin-

cipal difference between these machines being the cubical contents of bucket, length of shovel boom and complete working weight of the machines.

Model K2 has a working weight of 18 tons as shovel, is equipped with ½-yd. struck measure bucket with manganese front and reversible teeth, 18-ft. shovel boom with 12½-ft. dipper sticks and chain-type crowd. It weighs 18 tons, compared with 14½ tons for the Model K. Crawler treads are 16 in. wide, and the over all width of the machine has been increased to 8 ft. 4 in., as compared with 8 ft. for Model K.

The same features and design are used on both models including 8-in. center pin, 71-in. diameter swing roller path, unit cast car body and unit cast machinery frame. Frictionless ball or roller bearings are used on all machine shafts and steering and propelling clutches will continue to be located inside the cab with no parts under the car body requiring attention or adjustment. The patented propelling feature permitting this machine to steer through independent reversible clutches for each crawler, allowing sharp turns to be made by running the crawlers in opposite directions at the same time independently of each other, is continued on the K2.

In addition to the shovel attachment, the Model K2 is also available with clamshall, dragline, skimmer, trench-hoe and crane attachments. It is simply a larger and heavier machine for contractors requiring increased bucket capacities and greater working ranges than have been available on the Model K.

Caterpillar Announces New Leaning-Wheel Grader

A new grader to team up with the Caterpillar 60 tractor, featuring a 42-in. lateral side shift of blade that can cut a bank of 60-deg. slope, is announced by the Caterpillar Tractor Co. This new grader, besides introducing new features of blade control, reach and range, has also the feature of leaning wheels.

The new grader—called the Caterpillar 60 leaning-wheel grader—adds the fifteenth machine to a line of

Caterpillar Leaning-Wheel Grader

Caterpillar graders, maintainers, elevating graders and planers, and meets new demands for range, reach, strength and versatility for road construction. The new grader is the heaviest of the Caterpillar blade graders, weighing 11,300 lb. without scarifier, and introduces a new centralized control system by which seven control wheels govern the nine important adjustments of blade pitch and position, wheel adjustment and steering.

Correct pitch of blade at all times, whether cutting or drifting, is maintained by the exclusive Caterpillar feature of 3-point control. The wide range and reach of blade are made possible by a 42-in. lateral side shift, by three positions of the connecting link between side shift and circle cross-bar, by three blade-position connections with the blade beams and by four positions at the extensible lifting links. The blade is thus enabled to make a high reach for bank cutting of 6 ft. 6 in. and can cut a slope of 60 deg.

The entire lifting mechanism is mounted on roller bearings—tapered roller bearings in the worm shaft, double-row ball bearings on the lift shaft and roller bearings for the compensating lift spring sheaves.

A new construction is also introduced for the knuckle arms of the leaning wheels, whereby a steel sleeve through the knuckle holds the heavy steel pin. The sleeve also acts as a spacer for the axle angles allowing the nut on the pin to be drawn tightly up to maintain rigidity. The knuckles pivot on the sleeve not on the pin.

A Tamping Roller for Compacting Earth Fills

A tamping roller for compacting earth fills for embankments, roadways and dams is now being produced by the American Tractor Equipment Co., Oakland, Calif., for sale through Caterpillar dealers. This temporary roller is stated to comply fully with the specifications of state highway departments and the U. S. Bureau of Reclamation.

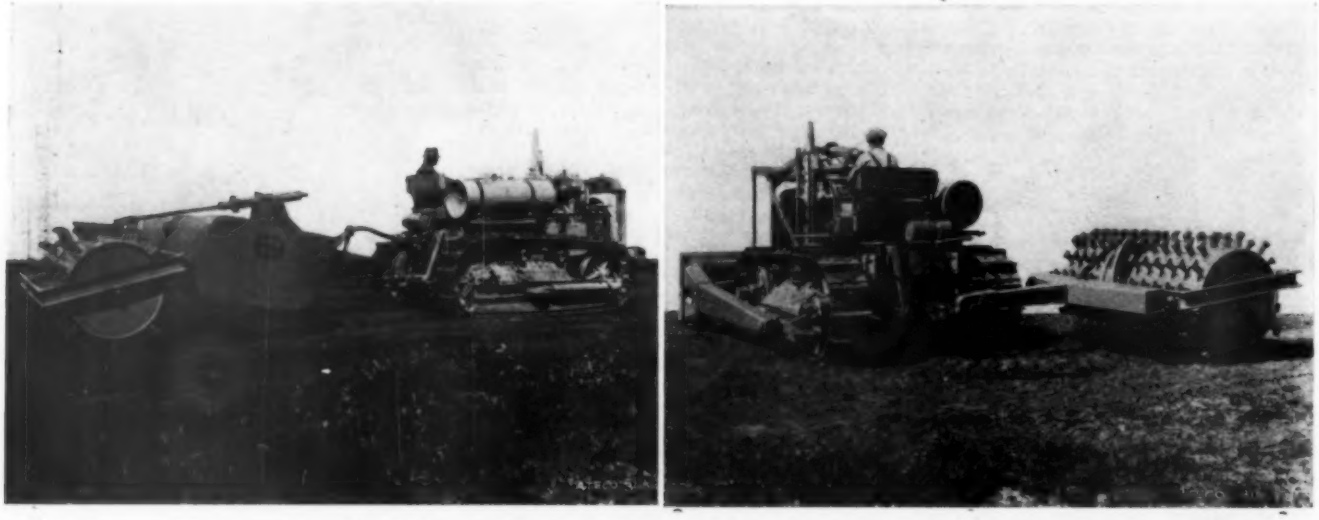
The Ateco tamping roller consists of two hollow, watertight cylinders, each 48 in. in width, to which are welded 112 ball foot castings. For normal work the weight of the unit, 5,485 lb., provides ample pressure on the tamping feet—665 lb. to each foot. When greater weight is required, the cylinders may be filled with water to increase the weight to approximately 8,800 lb., or 1,080 lb. per foot.

A removable cross-beam and slip tongue are furnished with the unit. Under normal conditions a Caterpillar 60 will easily pull two or three Ateco tamping rollers.

If desired the tamping roller may be used in conjunction with an Ateco dirt mover by removing the wheel assembly of the latter and substituting the roller. This requires but a few minutes and the removal of only two pivot shafts. With this combination the material is tamped as it is spread by the dirt mover, thus requiring fewer units, quite an advantage in close quarters. When tamping is not required the roller is easily detached and the wheel assembly put back into place.

Specifications for the Ateco tamping roller are as follows:

Model No.	TR-8
Number of sections	2
Width of each section, in.	48
Diameter overall, in.	52
Number of feet per section	112
Weight on each foot, lb.	665
Weight on each foot (with water) lb.	1,080
Shipping weight, lb.	5,485
Weight when filled with water, approximately, lb.	8,817
Water required to fill a section four-fifths full, gal.	200
Weight of combination dirt mover-tamping roller, lb.	7,900



The Ateco Tamping Rollers and the Hydraulic Dirt Mover Combined with the Rolling Tamper

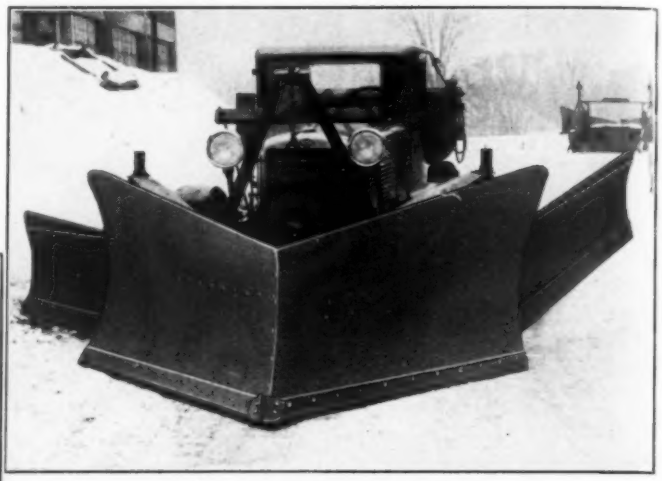
A Section Devoted to

SNOW REMOVAL

The Snow Removal Section of ROADS AND STREETS, beginning in this issue, will continue through October and November, presenting a comprehensive review of methods and costs of, and equipment for, clearing the highways and city thoroughfares

Truck SPEED Equipment

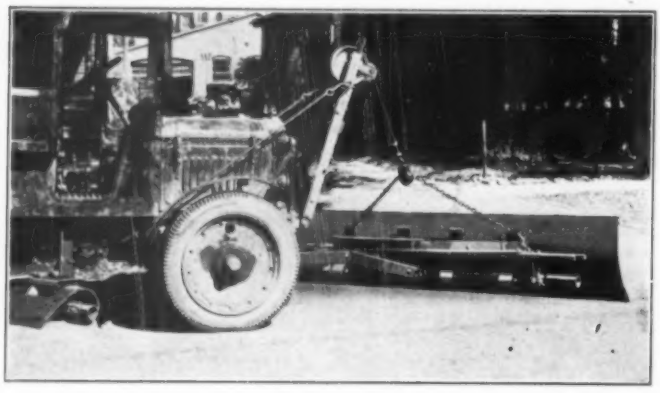
Root Big Buster V Plow Full Hydraulic operation; Hydraulic pressure generated by a small hand operated hydraulic pump operated by the truck driver or by mechanical operated hydraulic pump, power taken at the take-off on transmission.



Plow is heavy enough to stand the gaff of two large trucks in any depth of snow—Yet is easily controlled by the truck driver from his position at the steering wheel of truck.

Each Wing is raised by hydraulic pressure, but the new feature is the extending to any angle and folding of each Wing either together or separately with truck moving at full speed.

Highway can be cleared to a wide width, yet either Wing can be quickly folded to allow vehicles to pass or in passing any obstruction. Each separate operation can be had by one pump, by merely opening a common globe valve that directs the pressure to the desired point.



A full line of V or Blade Plows, hydraulically operated are manufactured for any size truck from two ton up. A Blade or V Plow can be furnished for Ford, Chevy, or International 6 Speed Special. This model is also used on passenger cars.

ROOT SPRING SCRAPER CO.

KALAMAZOO, MICHIGAN, U. S. A.

Economics of

SNOW REMOVAL IN MAINE

Increase in winter motor travel more than pays for removal of snow from highways in the state of Maine

By LEMUEL D. BARROWS
Chief Engineer, Maine State Highway Commission

THERE seems to be in the minds of many an impression that during the winter months the state of Maine is buried to the tops of its pine trees in snow, and that sledding is apt to be rather poor during July and August. Occasionally we have a season which may approach such a condition, and sometimes a season without enough snow for a winter carnival. Average winter conditions in Maine, however, are not at all unbearable and hibernation applies mostly to bears.

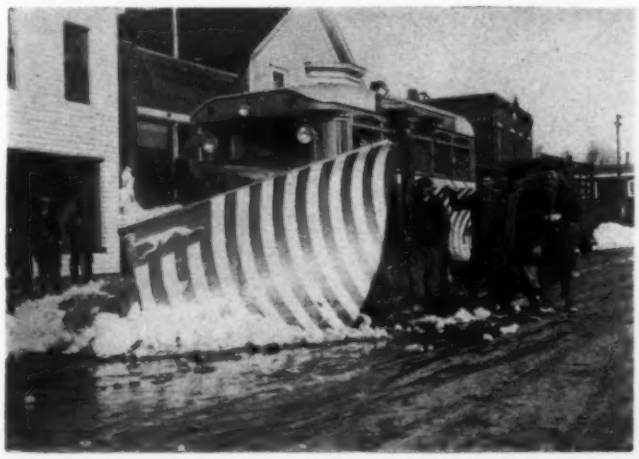
Snowfall Records.—According to records kept at the University of Maine in Orono, the average snowfall for 56 years previous to the winter of 1924 and 1925 was 59.23 in. for the months of December, January and February. For the same months of 1924 and 1925 the total snowfall was 52.5 in.; for 1925 and 1926, 76.5 in.; for 1926 and 1927, 69.8 in.; for 1927 and 1928, 54.6 in.; for 1928 and 1929, 40 in., and for 1929 and 1930, including December and January, 39.5 in. While total snowfall may be indicative of winter conditions, we do not feel that it is necessarily a measure of the cost of snow removal, as there are so many other factors which are pertinent—such as drifting and temperature conditions.

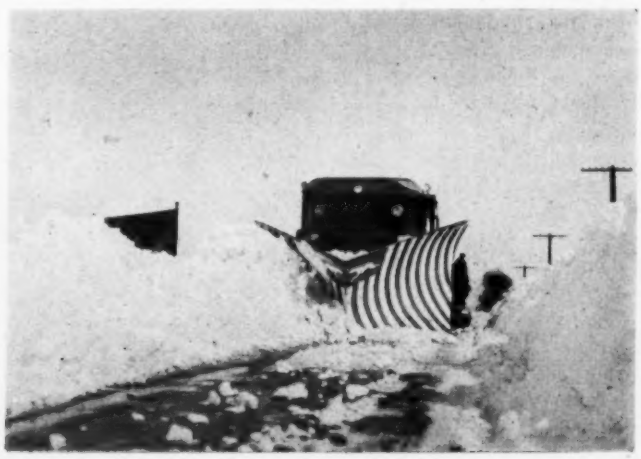
During the two seasons our snow-removal law has been in force we have had what we term open winters. There have been no severe storms with a large fall of snow within a short period of time and many storms have been followed by mild weather and even rain. We have much to learn through experience with severe winter conditions.

History of Snow Removal.—Individuals, trucking concerns, express lines, wholesale houses, oil companies, doctors, mail carriers and others in Maine, as in other states, have gradually motorized their transportation equipment and all have come to realize that snow removal is one of the problems to be considered in the development of highway transportation in order that the investment in motor equipment may be utilized the year around.

We find that the average assessed value of motor vehicles in Maine for 1929 was $229.14, which might seem to class us as a land of flivvers; but if we apply even this low value to the 180,000 vehicles registered we have a total value of over $41,000,000. While this is small compared with many of the other states, it is a large investment to remain idle for four months during the winter. (Beginning with this year we have a new tax law which provides a sliding scale of tax rates based on the manufacturer's list price.) We believe that the people of the state now feel that provisions to keep this equipment moving during the winter months are justified.

Previous to 1927 there were no clauses in our laws which provided for the participation of the state in any snow-removal work. Our laws placed upon the cities and towns the obligation to keep roads passable during the winter months, and this was never taken to mean passable for motor vehicles. As the use of motor vehicles increased, some of the towns purchased snow-removal equipment and proceeded to keep their roads open within local areas. Such towns reported that with proper equipment they could keep their roads open to motor traffic at less cost than the old methods which provided only for horse-drawn traffic.





Left—Type of Plowing Unit for Quick, Economical Results. Right—After Two Days and Two Nights of Continuous Fighting, This Was the First Plow South Out of Snowbound Chicago Last Winter

Heavy-Duty Tractor V-Plow Widening Path Opened Up with Truck Plow

Through the efforts of the Bangor chamber of commerce about 102 miles of city streets and about 111 miles of country roads were plowed during the winter of 1924 and 1925. This was done for the purpose of demonstrating that it was possible, and within reasonable cost, to keep motor traffic moving during the winter. The average cost per mile for the city work was $14.69 and for the country roads $20.93. During the winter of 1925 and 1926 an effort was made to keep open the highway from Kittery to Bangor by means of private subscriptions. While sufficient funds were not available to keep the entire length open, it was demonstrated that open winter roads in Maine were practicable.

Legislation.—These efforts, without doubt, supported and gave impetus to a growing demand for open roads, and in 1927 the legislature passed an act which provided state aid for this work. Our snow removal law does not give the state highway commission the authority to initiate a snow-removal program. The commission may approve the designation of a route for snow removal only upon petition of at least two towns along the route. Towns may petition for the approval of routes following designated state and state-aid highways, and also for the approval of town roads, for snow removal. The participation by the state in this work is not confined to any class of state roads. The law provides that the actual work of snow removal shall be done by the towns in a manner satisfactory to the commission, except that in case any town on an accepted route fails to provide equipment and to carry on the work, the commission shall cause the road in that town to be plowed at the expense of the state. If the town fails to pay to the state its proportional cost of the work, the governor and council may order the state treasurer to collect.

Provision is made that approved routes shall be cleared of snow for the reasonable use of motor vehicles, sleds and sleighs, and that not less than 3 in. of snow shall be left on the surface. This has caused some difficulty but more or less localized. Motor traffic wants all the snow removed and horse-drawn traffic insists on more snow. When 3 in. is left on the road mild weather often disposes of it. We plow as close as we can, taking local conditions into consideration. The demand that snow be left on the surface is far less than when work was begun two years ago. People have brought up the question of damage to roads by plowing and winter traffic. We do not find much damage on account of frost conditions when the roads are plowed wide. Road surfaces are damaged especially when enough snow is left on the surface to cause ruts and the concentration of wheel loads. Three years ago, before any organized attempt was made to keep the roads open, a lumber company operated trucks over one section of bituminous macadam during part of the winter. In the spring two ruts, from 1 to 3 in. deep, showed up for the entire length of the road. An inspection made this winter of two sections of surface-treated gravel road—one plowed close to the surface and the other left with a considerable depth of snow—showed the road surface intact where traffic could use the entire width and broken where deep ruts were formed in the deeper covering. This condition, of course, was to be expected. We believe that when properly plowed, road surfaces dry out and settle quicker in the spring.

Rental Rates.—In order to prevent confusion and misunderstanding in regard to rental rates charged by the towns for equipment, our law provides that the state highway commission shall, each year, establish a rental price for all snow-removal motor equipment which shall be approved as being adequate and economical for the work. The commission, for the present season, has established the following schedule of hourly rates, which includes grease, oil, gasoline, repairs, operator and snow-plow equipment:

Fordson tractor, Model F	$2.00
Fordson tractor, Model D	3.00
5-ton tractors	4.50

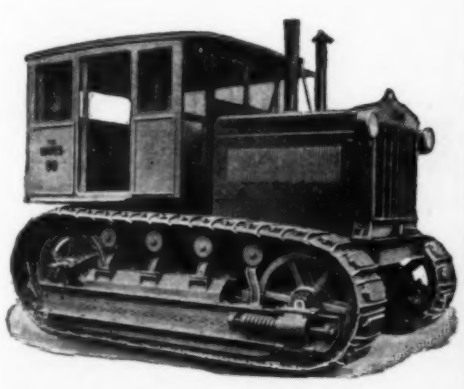
Tractor V-Plow on Illinois State Road. Crew Works Regular Hours Only; When 6 O'Clock Comes They Quit, Leaving Traffic Tied Up on Main Highway for Another Night

SHE PLOWS RIGHT THROUGH!

No need to worry about big drifts on the highway when you have the bigger, heavier Bates "80" bucking them.

The high road clearance — the extra weight — the tremendous reserve power — the long traction surface and the individual clutch operated crawlers keep the Bates "80" bucking into the drifts without slewing around under the pressure.

There are also Snow Specials Bates "35" and Bates "45" Tractors. » » » » Write for catalog.



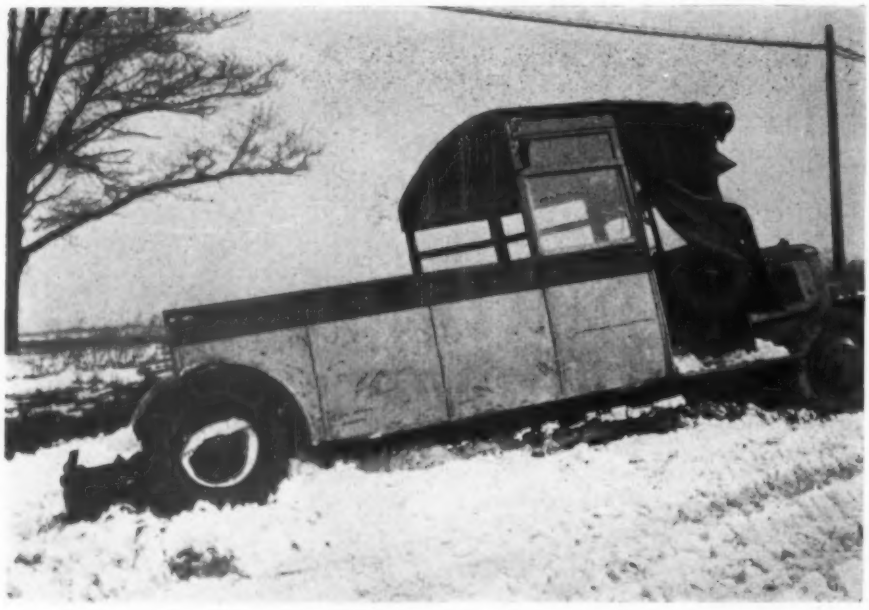
Bates "80" Special Snow Tractor

Manufactured by

FOOTE BROS. GEAR & MACHINE CO.

111 NO. CANAL STREET CHICAGO, ILL.

BATES Steel Mule



This Is What Happens When Drifts Obscure the Road Shoulders

6-ton tractors	6.00
10-ton tractors	7.00
1½-ton trucks	2.00
2-ton trucks	2.50
2½-ton trucks	2.75
3-ton trucks	3.75
3½-ton trucks	4.25
5-ton trucks	4.50
2½-ton trucks, all wheels driven	3.00
3½-ton trucks, all wheels driven	5.00
5-ton trucks, all wheels driven	6.00

These rates for trucks are for pneumatic tire equipment. Slightly lower rates are allowed for trucks with solid tires.

Plowed Width.—Our law fixes the minimum width of plowed road at 16 ft. on improved highways and the width of the wrought portion on unimproved sections, which has been fixed by the commission at 14 ft. minimum. The commission may also require a minimum width equal to the width of the metal surface on improved roads. We have assumed these minimum widths to apply to severe conditions and have tried to plow the roads as wide as conditions will permit.

Payment.—Towns are required to file receipted payrolls and bills covering the work and are reimbursed for 50 per cent of the cost up to a maximum payment of $25 per mile on the part of the state, if the work has been done satisfactorily. To provide state funds for this work the revenue from a 4-ct. gas tax for December, January, February and March is reserved for snow removal. Any part not used may be transferred to other specified funds at the end of the snow-removal season.

Snow-removal work has been placed in charge of the maintenance division and is under the immediate supervision of district supervisors—the same men who have charge of maintenance work during the summer season. The cost of such supervision is paid by the state and is not included as part of the cost in making reimbursements to towns.

General Requirements.—The following general requirements have been made to guide the towns in this work:

1. Snow should be removed the same width each side of the center. This should be done so that traffic can use the surface and not be forced on to the shoulders or even into the ditches.

2. When plowing the first snowfalls, the snow should be pushed to either side of the outside edge of each shoulder and generally not less than 24 ft. wide when the width of the road will permit. This will help to provide room to deposit the snow of future storms.

3. Plowing should commence after the fall of snow has reached a depth of 3 in. and operations should continue during the storm and until the road is thoroughly cleared.

4. Plows should be ready for operations any time in the 24 hours, Sundays included. Should drifting occur after the storm, plows should be run to clear the road.

5. Care should be taken not to leave too much snow on the surface, in order to prevent ruts.

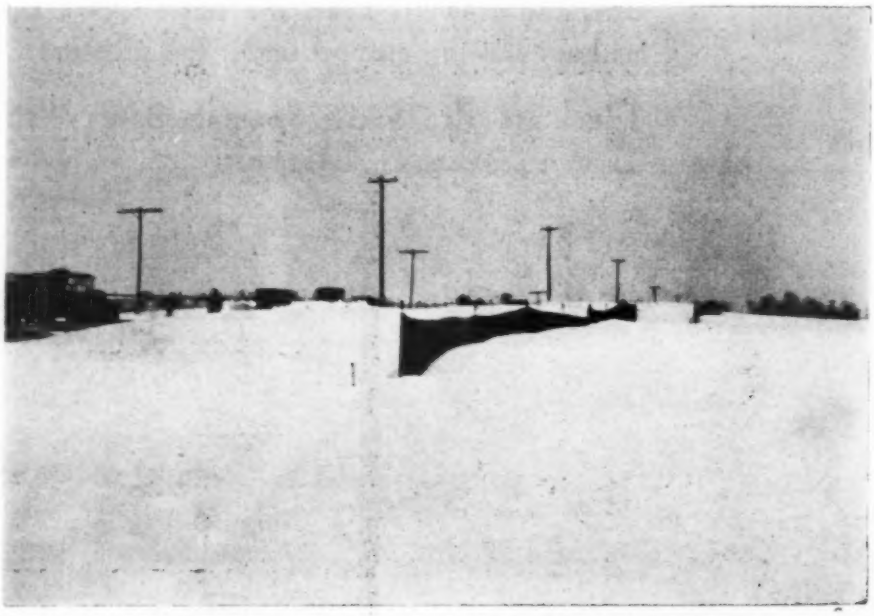
6. Snow - removal equipment should be such as to take care of maximum snowfalls and drifting conditions.

7. Snow fence should be erected at studied locations in order to prevent drifts.

8. Care should be taken not to destroy route markers, caution signs and guard rails.

9. Before snow removal commences municipal officers should go over proposed routes with the district supervisor to determine the mileage to be plowed and whether conditions will permit of plowing in accordance with the requirements.

Reports.—After each storm the supervisor reports to the department on all conditions pertaining to the work. At the end of the season each supervisor, with the municipal officers, checks up the exact mileage plowed and the length of snow fence erected, and this report is signed by



This Shows the Value of Snow Fence. Notice How Drift Has Covered Road Opposite Gap in Fence

FWD MORE than a Truck

FEATURES

Drives through front and rear wheels, brakes on all four wheels.

●

Steers as easily as a pleasure car.

●

A general service truck which adapts itself to special needs and provides more than economical transportation.

●

Furnished in 2 to 10 ton sizes, including four wheel, six wheel and tractor trucks.

●

Manufactured by the oldest and largest manufacturer of four wheel drive trucks in the world.

●

Have increased in sales 1084% in the past eight years.

●

Received 62% of 1929 orders from owners of FWD Trucks.

Keep Highways Open At Lowest Cost Per Mile!

THROUGH the heaviest snow drifts . . . up and down grades . . . FWD Trucks make way for travel . . . they keep the highways of the "Snow Belt" open . . . and they do so at the minimum of cost.

FWD Trucks make up the snow fleets of many states and counties because they have better traction and power due to the four wheel drive principle which distributes the power to all four wheels. They can be used with any type of plow and travel at a good rate of speed . . . . Besides snow removal, FWD Trucks can be economically used for all purpose road work. Send for special snow removal bulletin. Write today.

THE FOUR WHEEL DRIVE AUTO COMPANY, Clintonville, Wisconsin

CANADIAN FACTORY — KITCHENER, ONTARIO

BACKED BY NATION FWD TRUCKS **WIDE SERVICE**

Typical Drift Cleared by Tractor V-Plow

the supervisor and by the town officers.

Snow Fence.—From what experience we have had, we strongly recommend to our towns the use of snow fence. A few hundred feet of snow fence, properly placed, often saves the use of a heavy and expensive outfit for plowing. Generally we have located snow fence about 60 ft. from the road. This distance varies from 50 to 100 ft. In some places we have erected two lines of fence on the same side of the road. We allow towns a rental price of 3 ct. per foot for all snow fence erected and charge the same rental price when the fence is furnished by the state. This does not include the cost of erection or removal at the end of the season. Both items are, of course, included in the cost of snow removal.

Our law provides that the state highway commission, county commissioners or municipal officers may erect permanent or temporary snow fences on private property, subject to compensation to the owner. The owner has the right of appeal to the court in case the compensation allowed is not acceptable.

Statistics and Costs.—Our first experience with snow removal, as a state, was during the winter of 1927 and 1928. Snow-removal work was carried on in 217 towns and included 3,075 miles. Of this mileage 124 miles was kept open by the state with its own equipment. The average cost was $22.62 per mile. During the winter of 1928 and 1929, 266 towns were engaged in the work and a length of 4,283 miles was kept open to traffic. The state plowed 174 miles. The average cost was $28.52 per mile. Twelve miles of snow fence was erected the first season and last year this was increased to 68 miles. This year about 5,200 miles is being plowed, of which the state is plowing 150 miles.

During the first season 54 truck displacement plows, 107 tractor displacement plows and 3 tractor rotary plows were available for the work. Last winter 65 truck plows, 176 tractor outfits and 2 rotary plows made up the total equipment.

The state's equipment consists of eleven 3½-ton 4-wheel-drive trucks with Sargent plows and five tractor outfits. We believe that unless conditions are too severe, powerful, fast-moving trucks will accomplish the required results quicker and at less cost than the more costly and slower moving tractor equipment. We plan to hold the tractor plows in reserve at different locations so that they will be available when storms and drifting conditions are too severe for trucks. So far we have not found it necessary to use our tractors.

A traffic census taken at 26 locations in February, 1928, during our first season of snow removal, indicated a daily traffic of 15 per cent of the summer traffic at the same points.

The sale of gasoline during the months of December, January, February and March of the winter of 1927 and 1928, our first year of snow removal, was 4,324,000 gal. more than was sold during the same months of the previous winter, when there was no snow removal. The income from this increased sale of gas at the gas-tax rate of 4 ct. per gallon was nearly two and one-half times the total cost of snow removal to the state and the towns which cooperated in the work. This increase for the corresponding four months of the winter of 1928 and 1929 was 6,700,000 gal. and the income from the gas tax on this increase was two times the snow-removal bill of last winter.

Travel over our Kennebec River ferry at Bath for December, 1926, to March, 1927, inclusive, included 3,988 motor vehicles. The next winter, with snow removal, 15,137 motor vehicles passed over a new toll bridge at the same location during the same period. Last winter 16,729 motor vehicles passed over the

Motor Freight Lines Must Operate. This Crew Broke Drifts for Two Days to Open Snowbound Chicago

bridge during the four months. Registration of motor vehicles during the winter months of January, February and March increased from 47,900 in 1926 to 93,000 in 1929.

All of these conditions indicate a considerable increase in winter traffic since the beginning of our snow-removal operations. We know that the income from the gas tax on gasoline used for winter traffic alone will far more than pay our snow-removal bill and leave a large surplus for construction and maintenance work.

Last winter we recommended that our law be amended to provide for sanding to relieve ice conditions. This was not accepted. We have found it necessary, however, to sand some of the more important roads, especially on steep grades.

In the spring or during thaws, ditches and culverts are opened up when necessary and this has been charged to our ordinary maintenance work.

With so many towns cooperating in this work there are, of course, many opinions as to methods and equipment. Some towns have purchased adequate equipment and in some cases have arranged with neighboring towns to keep a certain mileage open. Other towns, individually or as a group, have contracted with some individual to furnish equipment and do the work. To provide modern, adequate equipment is a financial burden for many of our small towns, but on the whole they are joining with the state with a good spirit of cooperation. It is rather difficult always to obtain the results we think we should have, but we feel that we are providing better winter roads each year and that results have created a wider interest in winter roads.

I believe that the commission feels that in this cooperative work with our towns it cannot establish any hard-and-fast rules which might work a hardship on the towns, but rather the state department should encourage and assist the towns in every way possible.

Snow Removal on Primary Roads of New Mexico

By P. M. Bowen

District Engineer, New Mexico State Highway Department, Springer, N. Mex.

WHEN funds will permit, the maintenance of our highways may be considered as the work and material necessary to keep them in condition to meet the demands of traffic. Every person connected with highway maintenance knows that the present-day traveler demands a good road in winter as well as in summer. And why should he not? He is entitled to it, if ways and means can be provided.

In the discussion of snow removal, in forming a definite policy for a large area, there will always be an element of chance. Conditions are different in different localities and vary from year to year in the same locality. The amount and kind of snow, high winds and their direction, altitude and temperature all have a bearing on the uncertainty of the problem.

This is particularly the case on the highways of New Mexico, where the lowest temperatures vary from freezing to 40 deg. below zero, where the altitudes vary from 3,000 to 9,500 ft. and where, except in a few isolated sections, the snow problem may confront us only once every three to five years. New Mexico is more fortunate than her neighboring northern states in having the benefit of the winter sun and not having mountain passes and a large mileage of road built at high altitudes. We have the latter, but only in a smaller degree; and herein lies our problem, except for an occasional year when our plains and prairies bear the brunt of a severe storm.

Preparation.—The first essential in snow removal is preparation. The crews and equipment should be stationed in such places as to be ready for immediate call. Snow removal should begin during a storm and not wait for the roads to become impassable. Secondly, opening a road without clearing the full width is not snow removal. Roads only partly cleared are bound to suffer when the thaw comes.

Material a Variable.—Snow is a material of widely varying characteristics. It may be light and fluffy, weighing possibly 200 lb. per cu. yd.; or it may be wet, weighing possibly 1,200 lb. per cu. yd. It may resemble powdered sugar or it may be frozen. It may be level or in drifts. It may be lying still on the ground or it may be moving through the air, immediately refilling the roadway where cleared. This latter is particularly true in mountain country. The writer experienced such a condition two years ago when a Caterpillar 60 tractor was moving snow 2 ft. in depth over a 10-mile blow section; the wind-driven snow obscured the view and would backfill the road within an hour so that traffic could not travel.

Equipment.—There could be much discussion over trucks versus tractors and the types of snow plows with which to equip. The intelligence of the operator would have a large bearing on all of the results obtained.

Generally speaking, trucks are speedier and more adaptable to light snows and more mobile in shifting to different sections when little snow equipment is owned. Tractors will carry a larger plow and buck heavier drifts. From an economic standpoint, consideration should be given to all-year use of equipment when possible.

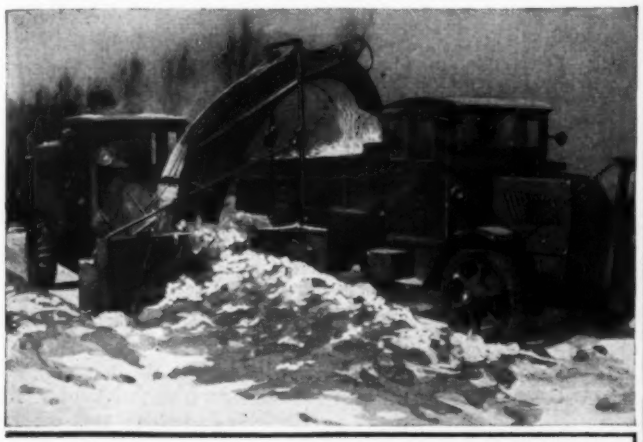
Bulldozer-Type Plow Clearing Through the Hills on New Mexico Road

SNOGO

The Super Snow Remover

SNOGO is an efficient all-purpose snow remover.

Our Snogo catalog tells a complete story of SNOGO'S mechanical features, and of its work under varied conditions. A copy of this catalog will gladly be sent upon request.

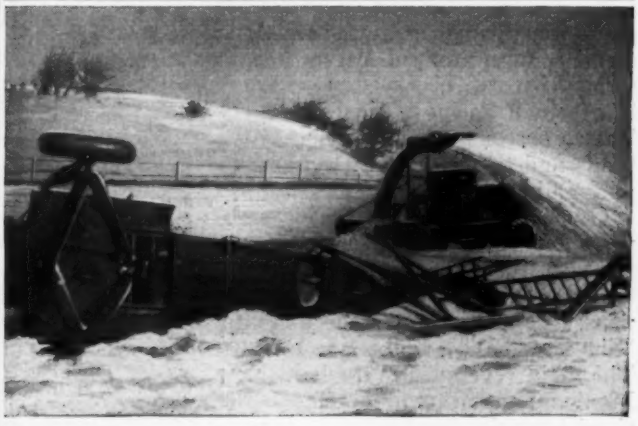


—for CITIES

It is difficult to conceive of an all-purpose snow-remover .... a machine that is efficient on city streets as well as on snow-submerged highways. But, there is a definite answer .... the new working principle of SNOGO with augers that cut into snow regardless of its condition, supplying the fan which develops tremendous force. Working on highways or on airports, this fan force disperses the snow up to a distance of 100 feet in *either direction*. For city work, this same force is under control by the application of a hood. By virtue of this force, the largest trucks can be loaded at the rate of 3 or more per minute (we have loaded them in less than 10 seconds) to many times their normal cubic capacity. The front hood

—for HIGHWAYS

can be operated right down to the pavement, and against the curb, accomplishing a *remarkably clean job.* Loading is done from the side, so that the trucks may follow in an uninterrupted procession. An important and exclusive feature of SNOGO'S work is the complete *removal of banks from highways.* If the banks are allowed to remain, they form drift traps, and after successive snowfalls, speed equipment is ineffective. Snow removal on airports is of vital importance. A few inches of snow can cause the loss of a ship worth many times the cost of a SNOGO, and the loss of lives — not to be measured in terms of money. SNOGO clears the widest airport runways, completely disposing of all the snow without building banks. ....



—for AIRPORTS

Klauer Manufacturing Co.

Dubuque, Iowa

Snow Removal on U. S. Route 385 near Mt. Capulin, N. Mex.

Plows of V-type, single-blade or bulldozer type and rotary type all have their place. The writer has found that the bulldozer type on a tractor can be used out of the snow season on sidehill construction and on fill work. The shape of the V-type plow should depend on the speed at which it is to be operated. The single-blade type should be reversible so as to push the snow all one way where prevailing winds require it. It is an advantage to have this characteristic in the rotary also.

Snow Fence.—The use of snow fence greatly decreases maintenance costs. The cost of snow fence at strategic locations is fully justified from the maintenance standpoint.

Losses and Benefits

Considering the actual cars in operation through heavy snows, one could compute this operating loss in terms of cost per mile; however, this is of small account considering the loss to persons who are kept off the roads and the tie-up of moving supplies and materials.

Our highways are a business investment and when lying idle they are like a factory shut down, except that the highway department's expenses continue and even increase. Who would allow millions to lie idle? The main revenue for roads in New Mexico, as in adjoining states, is derived from the gasoline tax. Assuming 400 cars per day using a road, the loss to the highway fund per mile of road per day, if closed, would be $1.33. Closing a road for four days would amount to $5.32 per mile, or sufficient in the estimation of the writer to remove a snowfall 18 in. in depth under ordinary conditions. Where snow is permitted to remain on earth, graded or rock roads and freeze and thaw, ruts and holes are bound to appear, thereby causing excessive maintenance costs. There are times, however, when a small snow is a benefit to graded earth and gravel-surfaced roads. When moisture is needed the snow can be left on in sufficient amount to meet this need. The writer has even resorted to the use of a road grader to bring snow from the ditches on to the road to secure the desired moisture.

Damage on Low-Type Surfaced Roads.—The writer has in mind a section of 10 miles of graded earth road on a through highway which, due to lack of snow equipment, had an 18-in. snow left on it for the action of the elements to remove. This required a period of 16 days, after which the direct cost of putting this road in good condition was $1,470.

Snow left on the road compels cars and trucks to use chains and concentrate in narrow lanes, causing rapid disintegration of low-type surfaced roads. On the oil type of surfacing it is essential that snow be removed not only from the oil mat itself but from the shoulders outside of the oil mat. Constant car traffic with chains will wear off the top oil seal, requiring a new oil seal coat to be added. Permitting snow to melt on the shoulders of an oil mat will cause moisture to enter under the edge either by direct flow or capillary attraction and break down the edge of the oiled surface. A case under the writer's observation occurred a year ago when almost weekly snows of from 4 to 8 in. occurred on a section of oiled road. The road joining on one end was of graded earth and on the other end was gravel surfaced. Snow was kept removed to the fullest possible degree; however, the adjacent graded road especially required cars to use chains and they would be kept on while passing over a 17-mile section of oiled road. Since this traffic passed by the highway office, a rough estimate was made during the winter two years ago, and from Oct. 15 to Nov. 10 of that winter 15,500 vehicles with chains were counted. The wear of these chains was such as to require a new oil seal coat on the road.

Cost.—Out of a total of 1,178 miles of road maintained under the writer's direction during the winter 1928-29, it was necessary to remove snow from 540 miles of this road at least one time. The total cost of this snow removal amounted to $14,650, not including interest and depreciation on equipment. Of this cost $6,740 was expended on 16 miles of road and this section of road was closed a part of the time in spite of our efforts. This piece of road is at

Drifts Get Deep, but Traffic Gets Through

BAKER SNOW PLOWS

For Motor Trucks And Tractors

They Have Served the Nation for Over Twenty Years

Baker Snow Plows have been at it for over twenty years. It pays to select from the forty odd models of "V" and blade plows for standard trucks and industrial tractors. Before you make your decision, be sure to get Baker's 56 page Snow Plow Catalog No. 290 full of the latest information on modern snow movers. If you need other tractor equipment, ask for our General Catalog No. 280.

BAKER TRACTOR EQUIPMENT
EARTH MOVING-ROAD MAINTENANCE-SNOW REMOVAL

Snow Plows ☐ Bulldozers ☐ Baker Maney Scrapers ☐

The Baker Mfg. Co., 506 Stanford Ave., Springfield, Ill.

Clearing the Highways

at 20 to 35 miles per hour

***with* FRINK SNO-PLOWS**

Such speedy removal of snow and ice from blocked highways is now possible because of the Frink's scientifically correct design and rugged construction.

Driving power is applied to the cutting edge of plow. This eliminates all possibility of buckling when high drifts are encountered.

These fast snow fighters operate on concrete, macadam, gravel or dirt roads with equal efficiency. Patented heel facilitates quick adjustment of cutting edge to fit road contour.

Frink's are readily adaptable to your present truck equipment and can be easily detached to free truck for other jobs.

A Frink on the job means "Business as Usual" on your highways every day of the year.

FRINK FEATURES

Plow will not wedge or buckle in high drifts.
Higher speed. Pushes one-third easier.
Inside control.
Quickly attached to any standard truck.
Readily adjustable to scrape road clean or leave several inches of snow as conditions demand.
Easily detached. Does not interfere with use of truck for other purposes.
No side thrust even when using only one side of plow.
Lifts clear for driving from one job to another.
Bevels the banks.

Insure open highways and uninterrupted traffic by writing TODAY for Sno-Plow Catalog No. 10.

Davenport Locomotive & Manufacturing Corp.
Davenport, Iowa

Licensed Manufacturers of Frink Sno-Plows for Illinois, Wisconsin and States West of the Mississippi

an elevation of 8,600 ft. and passes through the middle of a valley between two high ranges of mountains.

A 3½-ton truck with V-type plow and a 10-ton tractor with one-way reversible plow were used on the work. The wind blows continually from one direction, making it necessary to move the snow all one way from the road. This equipment was run 24 hours a day for a long period and in below-zero temperatures.

Conclusion.—Wherever there is population, no matter how sparse, or where there is travel, it is not necessary to promote snow-removal work. The traveling public is sold on all-year roads and the cleared highway in the winter is a necessity and no longer a luxury.

NOTE.—This discussion was presented at the fourth annual Highway Engineering Conference held at Boulder, Col., under the auspices of the Department of Civil Engineering of the University of Colorado.

Snow and Ice

The Perils of Winter Driving

By E. J. VAUGHAN

Maintenance Engineer, Oakland County, Mich., Road Commission

WINTER brings two of the most grievous things with which maintenance has to contend, snow and ice. I do not refer to the actual operations of removing snow, and sanding or removing ice; for these are merely questions of adequate organization and equipment. The grief comes in deciding just when to start in on such work. Either of these two operations is costly unless every move is made to count. It begins to snow during the day. By quitting time it is still snowing; yet not enough snow has fallen to warrant putting out the plows. Will it stop by 8 p. m., or will it continue on through the night? Will it remain calm, or will we get a drifting wind? Will morning find only a moderate amount of evenly-distributed snow on the roads, or will they be plugged with drifts? Shall the men be sent home for the night, or directed to report back at 9 p. m. or at midnight?

Or it may be a matter of ice. We get up any winter morning and find all pavements ice coated, or they may become sleeted over in an hour during the day. Immediately we begin sanding sharp turns, dangerous curves, difficult hills, busy intersections and all railroad grade crossings. We get that done. Now, what about the straight-away stretches? Will the sun come out, and will the ice be dissipated by afternoon, or will it stay on for days or weeks?

We seriously began clearing our roads of snow less than ten years ago. Today, with ice, we stand just where we stood regarding snow when snow removal was first considered. We're waiting around to see what the other fellow is going to do. Ice is taking a heavier toll in deaths, serious injuries and property damage than snow ever did. For the past winters in southern Michigan an increasing amount of the total charged against snow removal has really been for sanding ice or light traffic-packed snowfalls which turn into ice. Yet, even though it has already been costing some southern counties more to make iced roads safer at the most dangerous spots than it has for all their snow plowing, we have not tackled the matter of level, straight-away stretches in a straightforward, serious manner.

A road blocked with snow means that motorists will have to wait till the snow plows come through. A cleared road sheeted over with ice is an invitation to a driver to come on out and get killed or injured or have his car wrecked. It is going to be either one of two things, and the decision rests with road officials. When highways are icy, either the public uses them at its own risk, or we shoulder the responsibility and announce that we will remove or sand ice so that all roads will be reasonably safe for traffic.

In snowstorms, in any case of a reasonable doubt as to whether plows should be started out at once, or whether they should be held back, a policy of putting them out at once will, in the long run, be the most economical. Overcautiousness will inevitably result in truck repair bills from bucking snow drifts that will not be necessitated if snow is plowed with the storm. If we are to be guided, in snow removal, by a paltry matter of dollars and cents, certainly in the case of ice it should be attacked even more vigorously when, in addition to the argument of the loss in property damage to taxpayers' cars on icy pavements, we add the extremely likely liability of serious injuries and deaths.

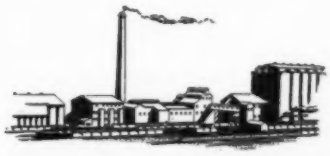
CLEAR ROADS FULL WIDTH.—Where roads are not cleared of snow for the full width, tremendous surface wear frequently results from confining traffic to a single lane. The damaging action of tire chains may cause rutting to such an extent that extensive repairs are necessary in the spring.

Snow-Fighting Equipment of an Illinois County

WHEN E. L. Gates, county highway superintendent of Du Page County, Ill., builds a road for service he services the road as clearly portrayed by the accompanying picture. Shortly after the heavy snowfall in the Chicago area last spring, the county roads of Du Page County were open. Those who travel those roads expressed much appreciation of the fact that the county roads were opened immediately.

Distributor News

New Factory Completed for Frink Sno-Plow



From a snow plow contrived ten years ago by Carl H. Frink of Clayton, New York, to meet local conditions, a manufacturing business has developed of such proportions that a new factory has just been completed to meet the market requirements in the eastern section of the country and arrangements have been made to allow the manufacture of the plows under the Frink patents to supply the section of the country west of the Mississippi.

New Plant of Frink Snow-Plows at Clayton, New York

Frink Sno-Plows, on which Mr. Frink holds patents in both the United States and Canada, have grown in popularity to such an extent that increased facilities were required, hence the new plant, located near the railroad in Clayton, 1000 Islands, New York. West of the Mississippi the plows will be manufactured and distributed by the Davenport Locomotive and Mfg. Co., Davenport, Iowa, as licensee under the Frink patents.

The manufacturers of this equipment are looking forward to a continued expansion, owing to the increasing interest in snow removal throughout the country.

American Steel & Wire Goes "Talkie"

One of the first successful "Talkie" industrial motion pictures has been produced by the American Steel & Wire Company, a subsidiary of the United States Steel Corporation.

Featuring a trip through the mills in which wire rope is made, the entire process becomes not only visible on the silver screen, but the illusion of actually being present is increased by the introduction of sound.

As each stage of manufacture is viewed, it is orally explained in a detailed and impressive manner. In this way many important points of interest, impossible to cover in the usual screen captions, are conveyed to the listener.

An added and novel feature is the use of lively music at certain spots where the action does not require conversation. This combining of entertainment with educational factors has proved unusually effective in maintaining interest to the highest possible pitch.

Although the adaptation of sound to industrial films is new, the remarkable success of this venture foreshadows a widespread use.

Manufacturers Organize Wire Reinforcement Institute

Announcement has been made of the establishment of the Wire Reinforcement Institute, by the manufacturers of welded wire fabric reinforcement. Headquarters will be located in the National Press Building, Washington, D. C. It is stated that the Institute will function as a purely promotional organization, its activities including the assembly and dissemination of authentic information, data and statistics relevant to welded wire fabric and its uses.

Mr. Royall D. Bradbury will conduct the activities of the Institute. Mr. Bradbury was formerly instructor in structural design at Massachusetts Institute of Technology, and later became vice-president in charge of the welded fabric department of the Clinton Wire Cloth Co.; and more recently he has been contract manager of the Aberthaw Construction Co. of Boston.

Engineers, architects, contractors and others wishing information concerning the properties or uses of welded wire fabric may avail themselves of the services of the Institute without cost or obligation.

Guiler to Represent Ateco in Pacific Northwest

Homer L. Guiler, for the past four years connected with Hofius-Ferris Equipment Company of Spokane, has been appointed district representative in the Northwest for the American Tractor Equipment Company, according to announcement of Edward R. Bacon, president of the firm, which manufactures Ateco earthmoving equipment.

Mr. Guiler, according to announcement, is thoroughly familiar with earthmoving, particularly in the Northwest, having been in the machinery business for 10 years, always as a salesman of tractors or graders. Prior to his connection with the Hofius-Ferris Company he was employed by the Connelly Machinery Company, "Caterpillar" dealer of Billings, Montana, and by the Northwest Equipment Company of Butte.

Homer L. Guiler

He has been assigned the entire Pacific Northwest for the American Tractor Co. and will cover Oregon, Washington, Idaho, Wyoming, Montana, Utah, North Dakota, South Dakota and Minnesota.

New Plant Underway for Maine Steel Products

Work is now underway for the new addition to the Cape City plant of the Maine Steel Products Company of South Portland, Maine. This company manufactures marine and industrial hardware, of which the Sargent snowplow is probably the best known.

The new plant will have 5,000 square feet of floor space and will provide for the final assembly operations on the snowplows and for loading them on cars for shipment. This is the 12th building used for manufacturing purposes in the two departments of the company.

It is said that last winter the company had more orders for their snowplows than they were able to fill, and it is in anticipation of an even greater demand this year that expansion facili-

ties have been undertaken. The crane ways in the new plant will be of structural steel, electrically welded, and the frame will be covered with steel siding. It is said that plant No. 10, where the heavy manufacturing operations of the plows take place, was the first electrically welded building to be used for industrial purposes in New England.

The development of the Sargent snow plow was brought about by the need of Mr. Don Sargent, in 1918 a lumber operator in Northern Maine, for a cleared road for hauling his logs. Through experimentation with crude plows he perfected the present product. The demand of paper companies for the plows led Mr. Sargent to devote all his time to their construction.

Last year the plows were shipped over the entire snow belt of the United States and as far west as British Columbia in Canada. A number have also been exported to Poland and Russia.

Universal Atlas Makes Webb District Manager

Announcement made by F. K. Stone, general sales manager, of the Universal Atlas Cement Company, states that C. A. Webb has been appointed district sales manager to succeed W. L. Greenly who has been transferred to the general sales office.

Mr. Webb has been connected with the Universal Atlas company for thirteen years, serving in the sales department and also as technical service engineer. During the World War he served as an officer in the U. S. A. in France. He is a graduate C. E. from the University of Arkansas and has also taken a degree from Columbia University.

Prior to joining the Universal Company Mr. Webb was engaged in valuation work for the St. Paul R. R. and also had charge of highway construction and maintenance for the American Tar Company, Boston. He also helped to design the double-tracked railroad structure in the Union Station for the Kansas City Terminal Railway Company in Kansas City.

He is a member of the Western Society of Engineers and of the Builders' Club, and an associate member of the American Society of Civil Engineers.

Speeder Machinery Adds to Sales Force

Several additional district sales managers have been added to the sales organization through which the Speeder Machinery Corporation serves their patrons in the United States and Canada according to recent announcement. This company manufactures gasoline, electric and Diesel powered shovels, cranes and draglines and is located in Cedar Rapids, Iowa.

R. F. Sanchez has been made export manager with offices at 50 Church Street, New York; B. C. Larrabee, district sales manager, Seattle, Washington; Harry E. Zabel, district sales manager, St. Paul; W. A. Avery, district sales engineer, Chicago; and R. C. Higley, Dallas, Texas. A. D. Lane, formerly with the St. Paul office, has been transferred to the central southwest territory with headquarters at Kansas City.

William Dudley Foulke

Mr. William Dudley Foulke, for many years treasurer of Western Wheeled Scraper Co., Aurora, Ill., passed away July 23, aged sixty-two years. Mr. Foulke was well known through personal contact or correspondence by most of the earthmoving contractors in the United States. When a young man, thirty-six years ago, Mr. Foulke joined the organization with

William Dudley Foulke

which he became so closely identified. His genius for detail, his wonderful memory and unswerving loyalty to his company and associates, made him invaluable and in time advanced him to the position of treasurer. Much of the development of the Western Wheeled Scraper Co. was due to his sound judgment and initiative.

Mr. Foulke was conspicuously a home man. In later years, defective vision confined his social life largely to his home and he lavished on his family a care and affection that most men spread over many interests. His life was filled with good deeds and kindly service, so quietly performed, and in such a self-effacing manner, that it truly can be said that "his right hand knew not what his left hand was doing."

All who came to know him well loved him. His wit and humor were a constant joy, and his strength and sweetness of character, an unfailing inspiration. His entire life was marked by a supreme courtesy, which was not a mere social veneer but the natural expression of a great soul that invariably recognized the rights of others.

Good Roads Machinery Loses Manager Pittsburgh Office

A. E. Konzelman, manager of the Pittsburgh sales branch of the Good Roads Machinery Company, was stricken with a sudden heart attack while calling on a prospect in Elwood City on July 8th, and passed away almost immediately.

Mr. Konzelman's long and varied experiences in engineering and construction work brought him in touch with a wide circle of acquaintances, and his frankness, sincerity and truthfulness gained for him the regard and confidence of all with whom he came in contact. He had made and kept a host of friends by whom his loss is keenly felt.

He was 51 years old, and is survived by his widow and a brother.

Standard Motor Construction Makes L. S. Devos, Sales Manager

Announcement has been made by Benjamin C. Smith, president of the Standard Motor Construction Company of Jersey City, N. J., of the appointment of L. S. Devos as general sales manager. Mr. Devos will have charge of the expansion program of the company for merchandising the full Diesel marine and stationary engines made by Standard.

In announcing Mr. Devos' appointment, Mr. Smith stated: "Additional outlets for the increased production of our present and contemplated product makes it necessary to enlarge our present sales organization. Because of Mr. Devos' broad and successful experience in the automobile and boating fields, as well as his knowledge of foreign markets, he is peculiarly fitted for the responsibility in organizing an adequate merchandising international organization."

New Distributing Company for Wyoming District

Announcement has been made of the organization and incorporation of the Wortham Machinery Company, located at 608 West 18th Street, Cheyenne, Wyoming, which will handle a complete line of contractors' and construction equipment.

Mr. John R. Wortham, formerly treasurer and general manager of the H. W. Moore Equipment Co., of Wyoming, Inc., resigned from this organization to become president and general manager of the new company.

The Evolution of the Wheel

Starting back in the days of the early Egyptians transporting their loads on skids and rollers, a fascinating story of the romance of the wheel is presented in a little booklet written by W. F. Heesch, general manager of French & Hecht, Inc., wheel manufacturers. Development of uses for wheels and wheel engineering is described and illustrated.

The Independent Pneumatic Tool Company, Chicago, manufacturers of Thor Pneumatic and Electric Tools, have appointed Mr. C. T. Connelly manager of the Buffalo office. Mr. Connelly formerly worked in the Michigan territory out of the Detroit office.

Service Exchange Department is to assist in building up strong distribution organizations. Use it.

20 miles by *Road* - 1 hour by *clock*

HAVE you noticed that many of our automobile manufacturers now advertise that their cars are good at going slow? Choked highways everywhere thwart America's desire for speed and ability to use it safely.

Yet no country in the world is more "sold" on the good roads ideal. Two billion a year is spent on it. And 83 per cent of our roads are *still* unimproved! Before we ask for "more money for roads," hadn't we better study the possibilities of "more road for the same money?"

Wider—smoother—safer roads. The low cost of Tarvia "Re-Tread" construction and maintenance will bring any community nearer to these goals. Meager road appropriations develop possibilities of greater accomplishment after one investigates Tarvia "Re-Tread" costs.

The Barrett organization is not a recent convert to, but the *originator* of, the low-cost idea. It can be of immeasurable assistance to the community that wants *more* road for the money.

The Barrett Company

New York	Chicago	Philadelphia
St. Louis	Minneapolis	Boston
Detroit	Cleveland	Birmingham
Buffalo	Columbus	Milwaukee
Providence	Syracuse	Cincinnati
Baltimore	Toledo	Rochester
Lebanon	Youngstown	Bethlehem
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In Canada:
THE BARRETT COMPANY, Ltd.
Montreal, Toronto, Winnipeg, Vancouver

Tarvia "RE-TREAD"

TRADE MARK REG. U. S. PAT. OFF.

Cornerstone Duly and Truly Laid

At 4 p. m., on July 30th, the formal laying of the cornerstone of the new experimental and research laboratories of the Hercules Powder Company took place at Hercules, Del., three miles west of Wilmington, near Lancaster Pike. The purpose in moving the laboratories from Kenvil, N. J., was to provide new facilities and to be closer to the main office.

It is stated that the cost of the new construction will amount to more than half a million dollars, on a site of more than 300 acres. Steel work on the main building is now up, and the railroad switch from Landenburg branch of the B. & O. is completed.

Two sealed boxes were placed in two front cornerstones. One contained records and history of Hercules Powder Company sealed in copper box in atmosphere of pure nitrogen, and the other contained some of the products of the company, terpene products and cotton linters. The speakers were Russell H. Dunham, president of the company, and George M. Norman, technical director.

C. B. Spicer Retires

After 43 years of continuous service in the explosive business, Charles B. Spicer, resident manager of the St. Louis office of the Hercules Powder Company, has retired, according to recent announcement.

Born in St. Louis in 1869, where he received his education, Mr. Spicer entered the explosive business as an office boy for the Hazard Powder Company, subsequently becoming a salesman for them. He went to Pittsburg, Kansas, as an explosives sales agent, and in 1913 was made manager of the Pittsburg office for the Hercules Powder Company. In 1921 he was transferred to his home town as resident manager in charge of the Southwestern district.

Mr. Spicer, while in Pittsburg, Kansas, was active in civic affairs, serving as president of the Chamber of Commerce, and also was Exalted Ruler of Elks. He is now making his home at 742 Boland Drive, St. Louis.

Samuel Hunt Joins New Batavia Co.

With directors and officers named, the recently organized Contractors Machinery Corporation has taken over the business and property of the Ferguson-Allan Company, Batavia, N. Y. The two firms have no connection, the Ferguson-Allan Company having been dissolved and the new company having purchased its properties, will use same to manufacture and rebuild contractor equipment and tools.

Samuel J. Hunt, formerly sales manager for the Wiard Plow Company, has assumed the duties of vice-president and general manager of sales for the new concern. Frederick W. Allan is president and managing director, and Louis Wiard, president of the Wiard Plow Company, is chairman of the board of directors. Other directors are Walter W. Stroh, secretary; Robert G. Allan and E. R. Fletcher, all of Batavia, and James Carter, treasurer, of Buffalo.

S. J. Hunt, Vice-President and Sales Manager, Contractors' Machinery Corporation

The new company will manufacture and sell "Trojan" tractor equipment and contractors' tools, and plans are now going forward so that by October 1st, it is expected between twenty and thirty skilled workmen will be at work.

Hercules Modernizing Carthage Plant

Nine new buildings, modern in design and equipment, are to replace thirteen small buildings in the Carthage plant area of the Hercules Powder Company, according to recent announcement. Estimated cost of improvements is placed at $175,000. Removal and installation of material and machinery will account for much of the cost incurred.

It is stated that contracts will not be awarded because of the company's ruling regarding the number of men working in explosive areas. Installation is being carried out by Hercules employes under the direction of plant superintendent, J. S. Marks of Carthage, and construction engineer, R. K. Hallett of Wilmington, Delaware.

Independent Pneumatic Tool Opens Los Angeles Office

A branch sales office of the Independent Pneumatic Tool Company of Chicago has been opened at 6200 East Slauson Avenue, Los Angeles, Calif. A complete line of Thor electric and pneumatic tools as well as spare parts will be carried in stock, to assure prompt service for the Los Angeles district.

Vernon Job, formerly manager of the San Francisco office, will be in charge of the new office, assisted by B. J. Herron.

W. H. Searight Joins Sales Force of Joy Mfg. Company

Mr. William H. Searight, for several years with the American Gas Accumulator Company as western manager, has recently joined the staff of the Joy Manufacturing Company, Franklin, Pennsylvania, as assistant sales manager in charge of snow loading and surface material handling development.

Mr. Searight, it is said, will devote his entire time to the development and sales of surface loaders carrying the Joy gathering device now used in under ground coal mines.

European Correspondent for Link-Belt Co.

William Piez, brother of Charles Piez, chairman of the Link-Belt Company, has been appointed European correspondent, according to recent announcement of Humphrey L. Kiely, head of the export division of the company will be Hotel Lutetia, 43 Boulevard Raspail.

Two Carloads of Good Roads

Glendive Tractor and Equipment Company of Glendive, Montana, will distribute the Ateco dirtmovers and bulldozer to some contractors in Montana and North Dakota to help make smooth the way of the tourist.

This is just one day's shipment to Glendive from the American Tractor Company of Oakland. Other large shipments have preceded this to supply the needs of the road builders in the territory served by this distributor.

L. E. McLaughlin, Inc., moving their 72-ton capacity Blaw-Knox BATCHERPLANT (with Weighing Batcher attached) near Poughkeepsie, N. Y.

ITS EASY TO MOVE YOUR BATCHERPLANT

All Blaw-Knox Batcherplants are designed to be quickly and easily handled, erected and moved.

The measuring equipment—Weighing Batchers, Volume Batchers or the Inundation System—is shipped attached from the factory and need never be dismantled when moving the bin.

There's a BATCHERPLANT immediately available to suit your job—any size; any capacity; with one, two, three or more compartments.

It pays to deal with Blaw-Knox—you get a time-proven quality product.

BLAW-KNOX COMPANY
2031 Farmers Bank Building
PITTSBURGH, PA.

New York, Chicago, Boston, Philadelphia, Birmingham, Buffalo, Cleveland, Detroit, Baltimore

Export Division
Blaw-Knox International Corp., Canadian Pacific Bldg., New York, N. Y.
London, England, New Oxford House, Hart St., Holborn, W. C. 1.
Paris, France, 1 Rue de Clichy
Milano, Italy, 6, via S. Agnese, 6
Dusseldorf, Germany, 17, Bismarckstrasse

BLAW-KNOX

Yes—we would like you to mention ROADS AND STREETS.

Service Exchange

for Manufacturers or Distributors

Editor's Note.—From time to time we receive letters from distributors wishing to be put in touch with manufacturers of certain lines of equipment, or from manufacturers seeking representatives of their products. Items of this kind will be published and names and addresses furnished interested persons upon request.

New Lines Wanted

Manufacturer's representative, covering Massachusetts, Rhode Island and southern New Hampshire, would like to secure line of speed reducers and gears.

Manufacturer's representative with 25 years sales experience, conversant with all types of pumps and their field, desires agency for either New York or export territory, or both.

A Michigan distributor, with many years' experience, representing at this time prominent manufacturers of pumping machinery, offers the services of an established representative to manufacturers needing increased facilities in this region.

Diesel engine account, road building material and equipment line, and industrial equipment and materials seeking representation in south wanted by Florida distributor. Large warehouse facilities.

Manufacturers' representative now handling centrifugal pumps would like to secure other lines in water works field. Covers eastern Pennsylvania, south Jersey and Delaware.

Manufacturer's representative located in New York City, now handling pumping machinery, would like to take on two or three additional lines serving the same field as his present account.

Wanted agency for any type of building specialties or contractors' machinery except mixers. Twenty years experience. Familiar with all types of contractors' machinery. Could act as sales manager for Atlantic Coast line with dealers.

Will handle signs, signals, road markers or other equipment for traffic on streets or highways.

Warehouse facilities for serving Pittsburgh territory. Would like to secure line of portable and stationary conveyors.

Michigan distributor would like to add two or three good lines to serve territory in southwestern part of state.

Representative in Northwest desires to handle, on commission basis, line of road building and maintenance machinery, revolving scrapers, tractors, rotary snow plows and V push plows.

A Michigan distributor, with many years' experience, representing at this time prominent manufacturers of pumping machinery, offers the services of an established representative to manufacturers needing increased facilities in this region.

Equipment distributor in Pacific Northwest desires line of road building equipment, structural building equipment, dump bodies and truck hoists.

Machinery distributor, established in Porto Rico and Santo Domingo, would be pleased to make arrangements to take on new lines in these territories.

Wanted exclusive sales rights for state of Mississippi for line of automatic or self-loading wheeled scraper.

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Representatives Wanted

Well established manufacturers' representatives wanted to handle sand and gravel pumps and equipment, in key cities, by successful manufacturer of high grade dredging pumps and hydraulic dredging equipment. Give character of equipment now being handled and territory covered.

Attractive territory available for experienced men to handle contractors' labor-saving equipment by old established company. Equipment backed by national advertising.

Manufacturer of complete line of construction equipment, mixers, saw rigs, plaster and mortar mixers and pumps has an open territory in the state of Maine and is looking for an aggressive distributor to represent him there.

Long established and well-known manufacturer of industrial locomotives wishes to make contacts with qualified distributors. Locomotive line includes steam, gasoline, gas-electric and oil-electric. Supported by national trade journal advertising.

Manufacturer of patented luminous highway danger signs and signals is interested in securing aggressive representation in various parts of this country and Canada.

Attractive territory open in states south and west of Chicago by manufacturer of cut to length, easily erected standardized steel highway bridges, for spans up to and including 40 ft. Product sells to highway commissioners and superintendents.

Good territory and proposition for distributors wishing to take on a line of street and traffic signs.

Manufacturer of air compressors and contractors' tools has number of desirable territories open. Full co-operation will be extended to distributors.

Distributors wanted to represent improved type of snow fence. Good territory in various parts of country.

Manufacturer of contractors and builders levels and transits is seeking district sales manager. Exclusive contract given. Excellent territory still available. Backed by national advertising.

One of the leading manufacturers of surveying instruments in the United States is seeking responsible agents in all sections of the country. Instruments are nationally advertised in all leading engineering journals.

Manufacturer of patented reflecting signs and devices desires representative for New York City, Long Island, Westchester County and adjacent territory. Someone selling other products to municipalities preferred.

Manufacturer of Transverse Testing Machines desires to build up distribution organization in this country and abroad.

Several desirable states open. Wanted distributing organizations covering entire states by manufacturer of mechanical spreader.

Territory open in several states for representatives to handle grade-rippers, scrapers and plows.

Open territory in New York and New England states for aggressive distributor wishing to take on line of hoisting machinery and air compressors.

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26.2% Gain Over Same 1929 Period

Reports of the first six months 1930 sales of the Four Wheel Drive Auto Co., as compared with the same period for 1929, offer small comfort to Mr. Lugubrious Blue, for a gain of 26.2 per cent is the gratifying figure issued by the chief accountant for the company. "Twenty Years of Progress" is the slogan appearing on reports of FWD, as their records over that period of time since the establishment of their organization show a steady growth from year to year.

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Rolling Down to Texas

A carload of ATECO earthmoving equipment on its way to Texas to be welcomed by B. P. Clark Machinery of San Antonio. This equipment which is manufactured by the American Tractor Equipment Company of Oakland, California, and Peoria, Illinois, is sold exclusively through "Caterpillar" dealers.